

# The MF-211 System

*Users Manual*

**Charles River Data Systems, Inc.**

001807

4 Tech Circle, Natick, MA 01760 Tel. (617) 655-1800 TWX (710) 386-0523

**CADS**





# CHARLES RIVER DATA SYSTEMS, INC.

FOUR TECH CIRCLE  
NATICK, MASS. 01760  
TEL: (617) 655-1800  
TWX: 710 386 0523

April 28, 1981

Below is the latest approved list of Floppy Diskettes.

<u>TYPE</u>	<u>DESCRIPTION</u>	<u>DYSAN</u>	<u>VERBATIM</u>	<u>MAXELL</u>	<u>IBM</u>	<u>3M</u>
Single Sided Single Density	Equiv. IBM Diskette I Soft Sector	800-514	3202(CAS-8) (FD34-9000)	FD1-XDM- 1200	1669550	740-0
Single Sided Double Density	Soft Sector MF211, FD211	800-518	7756(CAS-8) (FD34-8000)	FD1-XDM- 1200		741-0
Double Sided Double Density	Soft Sector FD411, MF411	800-850		FD2-XDM- 1200	1766872	743-0

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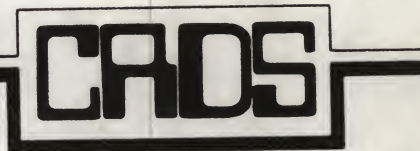


# The MF-211 System

***Users Manual***

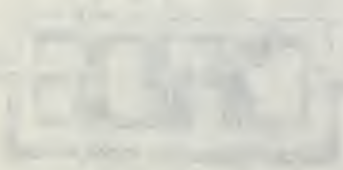
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THE M-21 SYSTEM

CLASSIFICATION



Charles River Data Systems, Inc.

1000 W. 10th Street, Suite 100, Lawrence, MA 01840



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FD-211

FC-201

FC-202

MF-211

The following terms used in this manual are trademarks or designations of DIGITAL EQUIPMENT CORPORATION:

RX-11

RX01

PDP-11

RX02

RT-11

LSI-11

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state of the economy.

2. The second part of the report  
describes the results of the  
survey and the findings of the  
research.

3. The third part of the report  
describes the conclusions of the  
research and the recommendations  
for further action.

4. The fourth part of the report  
describes the methods used in the  
research and the results of the  
analysis.

5. The fifth part of the report  
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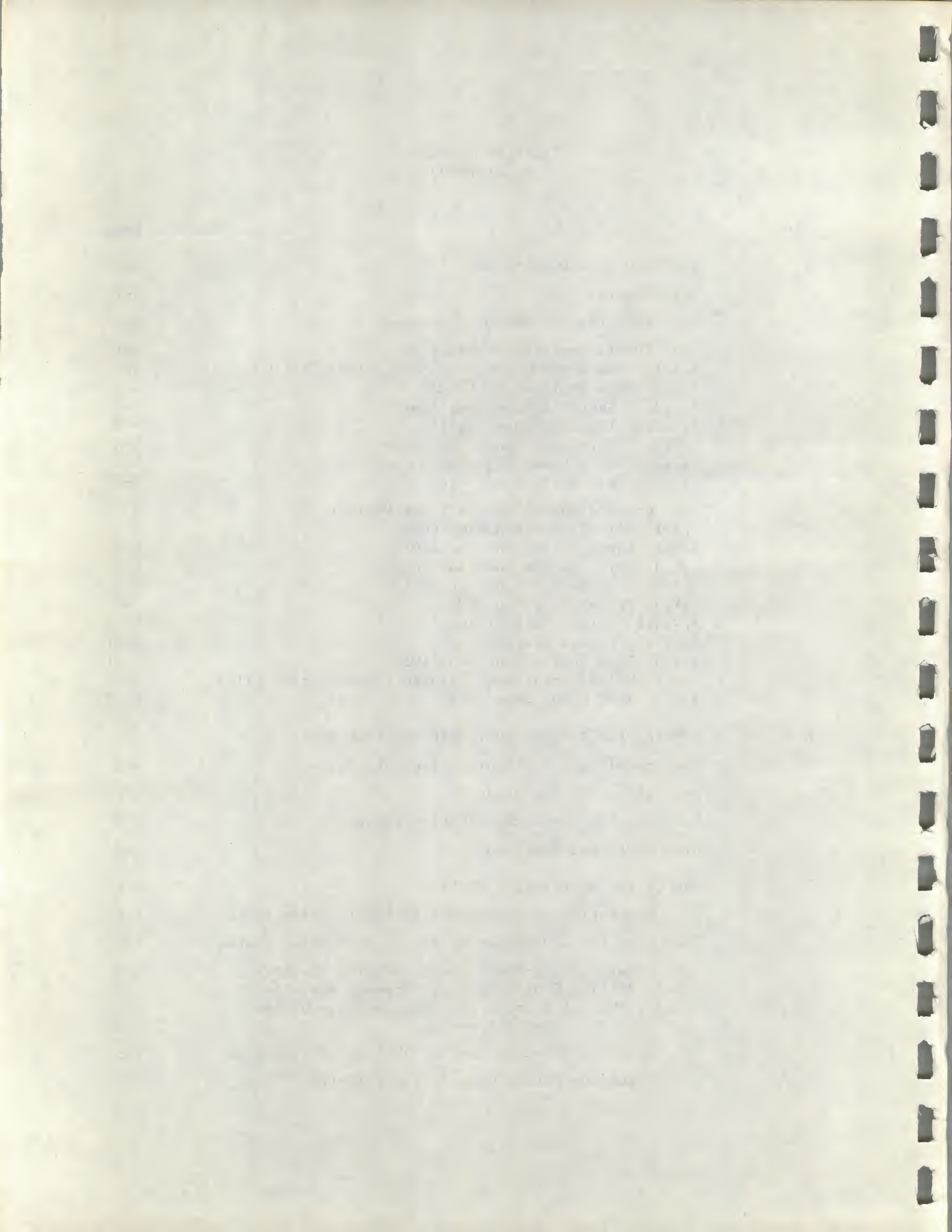




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## PREFACE

Charles River Data Systems started in 1973 as a manufacturer of mainframe computer memory systems. The company later diversified into the manufacture of add-on peripherals for the PDP-11 family of processors made by Digital Equipment Corporation. The CRDS FD-11 dual floppy disk drive system is a completely hardware and software compatible floppy system for the PDP-11.

The advent of the LSI-11 family of products has made the power and architecture of the PDP-11 system available to the small system user. With the technology developed in the FD-11 system and the expertise in computer systems available at Charles River Data Systems, a complete computer system became the natural extension of our product line.

The MF-211 system is completely software-compatible with the Digital 11V03-L system. It will, for example, run the RT-11 operating system without modification. It includes several standard features not found in the 11V03-L system such as individual unit write-protect, the capacity to format headers on a diskette, and to run self-test diagnostics on the drive system under microprogram control.

The complete MF-211 system will accept any standard DEC Q-Bus module for the LSI-11. It provides a cost-effective tool for small business, laboratory, and educational applications.

This manual will provide you with all the details needed to unpack, install, and use your MF-211 system. Please read the instructions completely and carefully before attempting to use your MF-211 system.







## Section 1

### INTRODUCTION

#### 1.1 GENERAL

The Charles River Data Systems MF-211 computer system is an integration of the Digital LSI-11, a Q-Bus backpanel, the CRDS FD-211 dual floppy disk system, and a power supply in one enclosure.

The MF-211 is available with either a four-slot standard backplane or an extended eight-slot backplane. The two versions differ only in backplane capacity; this manual applies to both configurations.

#### 1.2 SCOPE OF MANUALS

The following documentation is included with your MF-211 System:

- MF-211 Manual (you are reading it)
- DEC's Microcomputer Processors Manual  
(if you have ordered a processor)
- DEC's Memories and Peripherals Manual  
(if you have ordered memory or peripherals)

The MF-211 Manual is intended for use with the DEC Microcomputer Processors Manual. The MF-211 Manual will supply details for the unpacking, installation, and use of your MF-211 system, describe the floppy controller and drives, and will give details and specifications for the power supply. Details and specifications for the LSI-11 are contained in the Microcomputer Processors Manual. Details and specifications for the DLV-11, DLV-11J, DRV-11, and other DEC modules are contained in the Memories and Peripherals handbook. Memories supplied by CRDS are most often manufactured by either Monolithic Systems Corporation or by Digital Equipment Corporation. A separate manual is provided for these products when ordered.

#### 1.3 SYSTEM CONFIGURATION

The standard MF-211 Systems consist of the following:

- 1 - Four-Slot or Eight-Slot Quad Backplane
- 2 - Shugart SA800-Series Floppy Disk Drives
- 1 - FC-202 Floppy Disk Controller Card with Bootstrap
- 1 - Power Supply
- 1 - Enclosure with indicators and controls
- 1 - LSI-11/2 (KD11-HA)
- 1 - 32K Memory Card

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### 1.3 SYSTEM CONFIGURATION (continued)

Hardware options include:

4601            add-on memory in increments of 32K  
DLV-11F        serial interface for EIA RS-232 or 20 ma current loop  
DLV-11J        four serial interfaces for EIA RS-232  
DRV-11         parallel interface  
KEV-11        Extended Arithmetic Instruction PROM  
Any other standard DEC module for the LSI-11

Software options include:

RT-11 Version 3B Operating System  
Fortran IV  
Multi-User BASIC  
BASIC-11  
FOCAL  
APL  
Scientific Subroutine Package for Fortran  
RSX-11S    Operating System

The system is available for AC input voltages of either 110V or 220V at 50 or 60 Hz. It is supplied either with slides for rack mounting, or with rubber feet for desk-top use.

### 1.4 MF-211 SPECIFICATIONS

MF-211 Environmental Specifications:

Operating Temperature Range	15°C (59°F) to 32°C (90°F)
Storage Temperature Range	0°C (32°F) to 65°C (149°F)
Diskette Storage Temperature Range	10°C (50°F) to 50°C (122°F)
Relative Humidity	10% to 80% non-condensing
Cabinet Dimensions	10.5" H x 19" W x 22"D without feet 11" H x 19" W x 22" D with feet

1900

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#### 1.4 MF-211 SPECIFICATIONS (continued)

##### MF-211 Electrical Specifications:

Power Consumption  
(110VAC or 220VAC  
at 50 or 60 Hz)

450 watts (with FC-202, KD-11 HA,  
32K memory and serial interface)

750 watts (using the full 25 amps  
of the +5 volt supply)

Power Supply

Input: 110 or 220 volts  
50 or 60 Hz

Output: +5V 25 amps  
+12V 4 amps  
+24V 2.5 amps  
-5V 0.5 amps

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## Section 2

### SYSTEM OVERVIEW

#### 2.1 SYSTEM COMPONENTS

The MF-211 consists of two major elements: the LSI-11 processor and the CRDS FD-211 floppy disk system. These elements are combined in the same package and share the same power supply, thus providing a compact and cost-effective system. Additional backplane slots allow many other elements to be placed in this system.

##### 2.1.1 KD11-HA CENTRAL PROCESSOR UNIT

The standard processor supplied with the MF-211 system is the KD11-HA version of the Digital LSI-11. It is a sixteen-bit machine, featuring direct addressing of 30K 16-bit words, byte addressing, an asynchronous bus, hardware memory stack, DMA capability, vectored interrupts, and a powerful instruction set. The KD11-HA also includes a microcode control program in ROM, ODT (On-Line Debugging Technique), which allows the operator direct access to memory.

Complete descriptions of the KD11-HA are contained in Chapter 3 of the Digital Microcomputer Processors Manual. Chapter 4 of the same book describes the LSI-11 bus. The Manual will also detail the use of the ODT program, the processor instruction set, and specifications for DEC modules.

##### 2.1.2 FD-211 FLOPPY DISK SUB-SYSTEM

The MF-211 contains a dual density flexible disk system compatible with Digital Equipment Corporation's LSI-11 computer family. It is a direct replacement for Digital's RXV-21 (the LSI-11 version of the RX02) disk system. It provides double density data encoding allowing the storage of 512K bytes on a single diskette as well as single density capability. The single density mode allows access to programs written on older single density systems as well as an industry standard format to exchange data with other systems.

##### 2.1.3 OPTIONAL INTERFACES

Additional cards may be bought or built for interfacing the MF-211 system to peripheral devices. The DLV-11F or J serial interface is used for interfacing console terminals, modems, and other serial lines at speeds up to 19.2K baud (or externally clocked rate). The DRV-11 is a general purpose parallel interface. Additional interfaces are available for IEEE instrument bus, A/D and DAC, and so on.

Any user-constructed interface needs only to have sufficient circuitry for interface to the LSI-11 bus, or be built around a bus foundation card to work with the MF-211 system. Full documentation on interface requirements is available in the Microcomputer Processors Manual.



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#### 2.1.4 OPTIONAL MEMORY

The KD11-HA is capable of direct addressing of up to 30K 16-bit words of RAM. A single dual-height module can be ordered from CRDS which will bring the system memory to this total.

Most general applications will require at least 16K words to support an operating system, and 32K words is desirable for applications involving software development.

#### 2.1.5 BACKPLANE AND POWER DISTRIBUTION

The standard 4-slot backplane is large enough to support one KD11-HA, a DLV-11J, 32K of expansion memory, the FC-202 Disk Controller and still have four dual-height slots remaining.

The expanded 8-slot backplane has four additional quad slots or enough for eight more dual-height cards.

A multiple voltage power supply contained in a single unit provides the +5 volts, +12 volts, -5 volts, and +24 volts sources from which all required power in the system is taken. Section 9 of this manual describes and specifies the power supply.

#### 2.1.6 FRONT PANEL CONTROLS

The MF-211 System front panel controls provide for control of AC power, booting the system, moving the processor between halted and running states, and selective enabling of the Line Time Clock (LTC). Functions normally associated with a programmer's console, such as examination and modification of memory from the console indicators and switches, are provided by console emulation routines in the ODT monitor. These routines are entered whenever the processor is in the halted state.

### 2.2 FD-211 FLOPPY DISK SUB-SYSTEM

The MF-211 contains a double density floppy disk system. This system is equivalent to CRDS's FD-211 Floppy Disk Add-On product. The phrase "FD-211 Sub-System" is used to refer to the floppy disk controller and drives.

#### 2.2.1 CONTROLLER CARD

The controller card is based around a 2901 microprocessor which controls all reading and writing to the disk drives and emulates DEC's RXV-11 (RX02) instruction set. In addition, the FD-211 sub-system has the capability of completely formatting diskettes and bootstrapping the system.

This card plugs into any dual slot in any LSI-11 backplane. A 40-conductor ribbon cable connects this card directly to each of two disk drives that are connected in parallel.

## 2.1.1. GENERAL INFORMATION

The 20-211 system is a digital data processing system. It is designed to process data in a digital form. The system is capable of processing data in a digital form. The system is capable of processing data in a digital form. The system is capable of processing data in a digital form.

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## 2.1.2. SYSTEM DESCRIPTION

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## 2.1.3. SYSTEM OPERATION

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## 2.1.4. SYSTEM DESIGN

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### 2.2.2 ELECTRO-MECHANICAL

The Shugart SA-800 floppy disk drives are the industry standard. Each drive has an integral write-protect sensor allowing easy write protection of the diskettes. An LED mounted on the release button is lit whenever an I/O operation is occurring.

The proprietary ceramic read/write head extends media life to 3.5 million passes/track and has a lifetime itself in excess of 15,000 hours.

### 2.2.3 FD-211 COMPATIBILITY

The FD-211 Sub-System is completely compatible with DEC's RX02 instruction set and runs with DEC-supplied software or with any software designed to work with DEC's RX02 System.

## 2.3 MEDIA COMPATIBILITY

The FD-211 Sub-System is designed to operate with both single and double density diskettes. In single density mode, the FD-211 sub-system is compatible with IBM's 3740 format. This allows interchange of media with RX01 (or FD-11) systems as well as the equipment of many other manufacturers who use this industry-standard format.

The double density mode of the FD-211 sub-system, while being interchangeable with RX02 systems, is a standard only to Digital Equipment Corporation. No other mainframe manufacturer uses this particular double density encoding at the present time.

### 2.3.1 DISKETTE

The flexible diskette consists of a flexible mylar disk coated with an oxide and encased in a plastic jacket. The jacket is lined with a fiber material that cleans the diskette as it rotates.

Care should be used in both selecting and handling these diskettes as described in Section 4.5.1.

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Received of the Treasurer of the County of ... the sum of ... Dollars for ...

...

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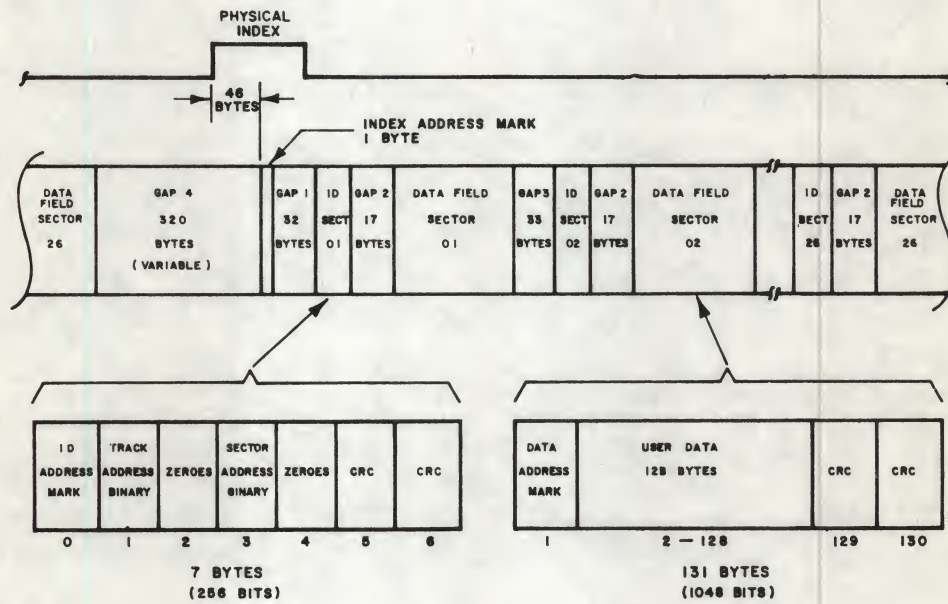
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### 2.3.2 SINGLE DENSITY FORMAT

In the IBM 3740 Data Entry System, each disk contains 77 tracks (0-76). Each track is divided into 26 sectors containing 128 data bytes. The organizations of sectors on a track is determined logically (soft sectoring) rather than mechanically (hard sectoring). The principal characteristics of this format are shown below:



IBM TRACK FORMAT

FIGURE 2-1

1887

Received of the Treasurer of the  
Board of Education the sum of  
\$100.00 for the year 1887

Witness my hand and seal this 1st day of  
January 1887

Attest  
J. H. [Signature]

By [Signature]  
[Signature]

Witness my hand and seal this 1st day of  
January 1887

Attest  
J. H. [Signature]



### 2.3.2 SINGLE DENSITY FORMAT (continued)

The headers, each seven bytes long, identify the track and sector being read. During normal operation, these headers are not written over. On both read and write commands, these headers will be read to identify the sector number and verify the track address.

After a gap, the data field will either be read or written.

Single density data is written using the FM encoding. Four microsecond bit cells, as shown in Figure 2-2 always contain a clock bit and also contain a data bit if a "1" is present.

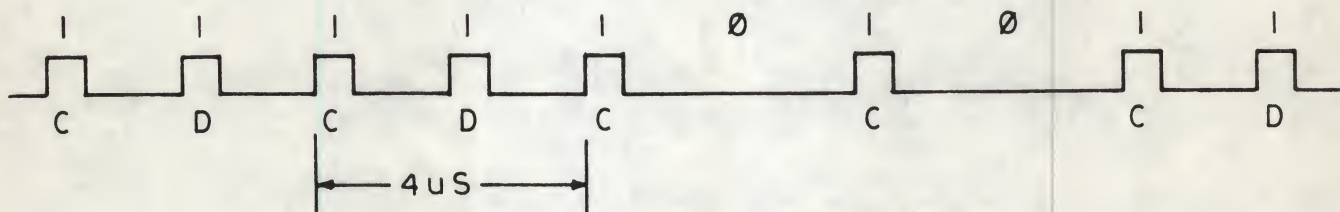


FIGURE 2-2

### 2.3.3 DOUBLE DENSITY FORMAT

The FD-211 follows the same double density format selected by Digital Equipment Corporation for use in its RX02 System. This format is NOT compatible with IBM's double density format.

The double density format in the FD-211 is actually the same as the single density format except for the data fields. The exact same single density headers are used so that a diskette may be used for either single or double density operation without changing the headers. The principal characteristics of the double density format are identical to those shown in Figure 2-1 except for the data field.

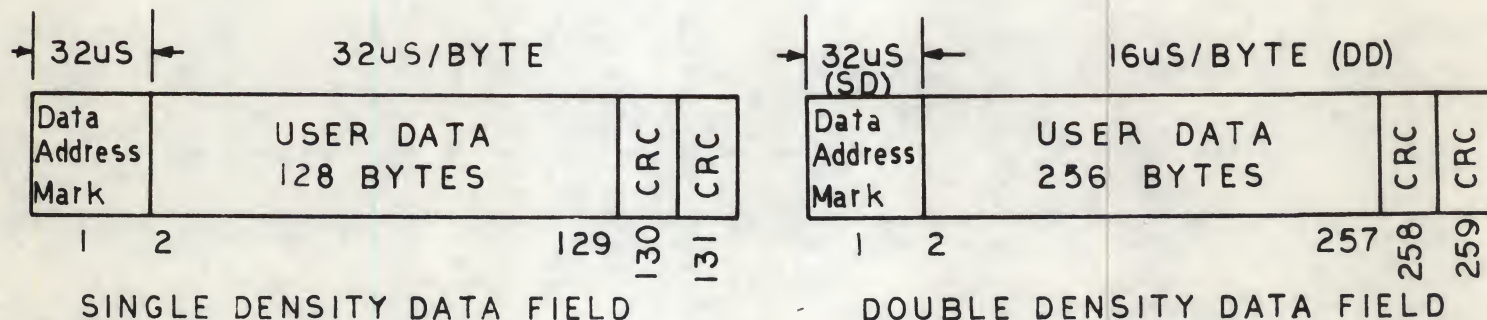


FIGURE 2-3

The first part of the paper is devoted to a discussion of the general theory of the problem. It is shown that the problem is equivalent to a system of linear equations. The coefficients of these equations are determined by the geometry of the problem. The system is then solved by the method of least squares.

The second part of the paper is devoted to a discussion of the numerical solution of the problem. It is shown that the numerical solution can be obtained by the method of least squares. The coefficients of the equations are determined by the geometry of the problem. The system is then solved by the method of least squares.

The third part of the paper is devoted to a discussion of the results of the numerical solution. It is shown that the numerical solution is in good agreement with the theoretical solution. The results are compared with the results of other authors. It is shown that the numerical solution is more accurate than the theoretical solution.

The fourth part of the paper is devoted to a discussion of the conclusions of the paper. It is shown that the numerical solution is in good agreement with the theoretical solution. The results are compared with the results of other authors. It is shown that the numerical solution is more accurate than the theoretical solution.

The fifth part of the paper is devoted to a discussion of the references. It is shown that the numerical solution is in good agreement with the theoretical solution. The results are compared with the results of other authors. It is shown that the numerical solution is more accurate than the theoretical solution.



### 2.3.3 DOUBLE DENSITY FORMAT (continued)

Figure 2-3 shows the data field format for double density as well as the single density format for comparison. The data address mark, which is rewritten on all write commands, designates the density of the data field. The table below gives the different designations used in data address marks.

MARK	DENSITY	DATA BYTE HEX	CLOCK BYTE HEX	STANDARD
DATA	SINGLE	F B	C 7	IBM 3740
	DOUBLE	F D	C 7	DEC
DELETED DATA	SINGLE	F 8	C 7	IBM 3740
	DOUBLE	F 9	C 7	DEC

FIGURE 2-4

The encoding technique used in double density is different from that used in single density. It is a variation on the MFM encoding technique used by IBM and other flexible disk manufacturers. The standard MFM encoding technique consists of 2 microsecond bit cells with clock bits only written when there are no data bits in either the present or previous cells. The data bits are written whenever a 1 is to be written. Figure 2-5 gives an example of this.

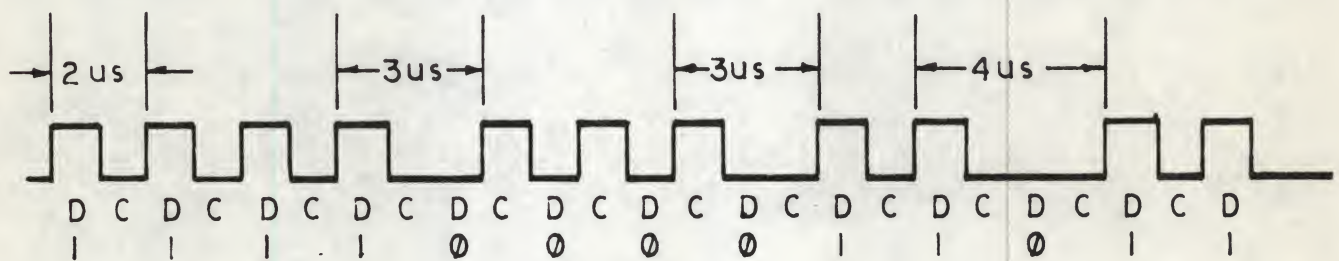


FIGURE 2-5

As can be seen from Figure 2-5 spacings of 2, 3 and 4 microseconds between flux changes are all possible. The fact that the address marks must be written with unique patterns so as to always be distinguishable from data for a soft-sectored controller presents a special problem. A single density address mark will be detected unwittingly if an appropriate two bytes of data is written in a double density data field. This danger is overcome by re-encoding a normal double density data pattern into a pattern with missing clocks. This is shown in Figure 2-6.

WHENEVER  $D_0 D_1 D_2 D_3 D_4 D_5$  APPEARS IN A DOUBLE DENSITY  
 $0 \ 1 \ 1 \ 1 \ 1 \ 0$  DATA FIELD,

IT IS WRITTEN AS

$D_0 \ C_1 \ D_1 \ C_2 \ D_2 \ C_3 \ D_3 \ C_4 \ D_4 \ C_5 \ D_5$   
 $0 \ 1 \ 0 \ 0 \ 0 \ 1 \ 0 \ 0 \ 0 \ 1 \ 0$

FIGURE 2-6

The first part of the report deals with the general situation of the country and the progress of the work during the year. It is followed by a detailed account of the work done in each of the various departments.

1. General Administration	2. Finance	3. Education	4. Health	5. Agriculture	6. Industry	7. Commerce	8. Public Works	9. Social Services	10. Miscellaneous
11. Total									

The second part of the report deals with the work done in each of the various departments. It is followed by a detailed account of the work done in each of the various departments.

1. General Administration	2. Finance	3. Education	4. Health	5. Agriculture	6. Industry	7. Commerce	8. Public Works	9. Social Services	10. Miscellaneous
11. Total									

The third part of the report deals with the work done in each of the various departments. It is followed by a detailed account of the work done in each of the various departments.

1. General Administration	2. Finance	3. Education	4. Health	5. Agriculture	6. Industry	7. Commerce	8. Public Works	9. Social Services	10. Miscellaneous
11. Total									

The fourth part of the report deals with the work done in each of the various departments. It is followed by a detailed account of the work done in each of the various departments.



### 2.3.3 DOUBLE DENSITY FORMAT (continued)

When reading double density data fields, the controller checks for a missing clock between 2 zero data cells and, if found, it substitutes in 2 ones for the 2 zero data bits.

An understanding of the format differences between single and double density described above will help the user understand the different format operations available to the user, listed in Section 5 of this manual.

### 2.3.4 CYCLIC REDUNDANCY CHECK (CRC)

Every ID and data field on the track has a pair of CRC bytes appended to it. These bytes, which are generated as the field is written, represent a cyclic permutation of all the data bits in the field, from bit 0 of the address mark to bit 7 of the last byte in the field (excluding the CRC bytes).

The cyclic permutation is the remainder that results from dividing the data bits (represented as an algebraic polynomial) by a generator polynomial  $G(X)$ . The polynomial used in the 3740 format is

$$G(X) = X^{16} + X^{12} + X^5 + 1$$

## 2.4 FD-211 SUB-SYSTEM SPECIFICATIONS

### Capacity

Bytes per sector:	128 (SD); 256 (DD)
Sectors per track:	26
Tracks per diskette:	77
Total bytes per diskette:	256,256 (SD); 512,512 (DD)

### Access Time and Rates

Diskette to controller buffer:	32 $\mu$ s/byte (SD); 16 $\mu$ s/byte (DD)
Buffer to CPU:	16 $\mu$ s/byte
Track to track:	8 ms
Seek settle time:	14 ms
Head load time:	41 ms
Rotational speed:	360 RPM +/- 2.5%
Average access (25 track seek and rotational latency):	320 ms

### Recording Technique

Method:	FM (SD); MFM Modified (DD)
Maximum bit density:	3200 BPI (SD); 6400 BPI (DD)
Track density:	48 TPI
Surfaces:	1

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DIVISION OF THE PHYSICAL SCIENCES  
DEPARTMENT OF CHEMISTRY

REPORT OF THE  
COMMISSIONER OF THE  
BUREAU OF CHEMISTRY

FOR THE YEAR  
1900

CHICAGO, ILL.  
1901

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1900

CHICAGO, ILL.  
1901



## 2.4 FD-211 SUB-SYSTEM SPECIFICATIONS (continued)

### Reliability

Seek error rate:	1 in $10^6$ seeks
Soft read error rate:	1 in $10^9$ bits
Hard read error rate:	1 in $10^{12}$ bits

### Environmental Restrictions

FD-211 operating range:	50 to 100 degrees F
FD-211 storage range:	32 to 150 degrees F
Diskette storage range:	50 to +125 degrees F
FD-211 humidity constraint:	10 to 80 percent without condensation

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Section 3  
UNPACKING AND INSTALLATION

3.1 UNPACKING

**CAUTION**

DO NOT LIFT UNIT BY FRONT PANEL.  
THIS WILL CAUSE DAMAGE.

The MF-211 is shipped complete in a single carton. The carton must be opened from the top (printing on sides of carton reading properly). Remove the slides, manuals, cables, and any modules from the packing material. The top section of the packing material may now be removed, exposing the MF-211 chassis. Reach down through the cut-away sections to each side of the chassis, grasp the unit from the bottom and lift it up and out.

3.2 MODULE AND CABLE INSTALLATION

The MF-211s are shipped with only the FC-202 card, the processor, and the memory card installed (if ordered). All other cards are left out so that the user can configure the parameters for each card (such as baud-rate settings on DLV-11s).

Cables need to be routed through the MF-211 so that the fan cooling the card cage is not blocked. The four-slot cage has plenty of room on top to route cables. The eight-slot cage has no such room so cables must be routed to the right of the fan under the cable guide and then out the back.

The standard MF-211 is configured as follows:

**KD11-HA Processor Jumpers**

Power up mode 2: Program execution will begin at location 173000 if the halt/enable switch is in the ENABLE position.  
ODT is run if the halt/enable switch is in the HALT position.  
LTC (event line) is enabled.  
KEV-11 is installed, if ordered.

**Memory Boards**

Set to provide contiguous memory from location 0 up to either 16K or 28K.

**FC-202 Floppy Disk Controller Card**

The bootstrap is enabled.

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### 3.2 MODULE AND CABLE INSTALLATION (continued)

#### DLVII-F Console Interface

RXCS Address 177560

Vector Address 60

FEH is installed (framing error halt - the BREAK key causes the processor to enter the HALT state)

Baud Rate is 9600

Both EIA and 20 ma current loop options are active (interface cable selects which is used)

#### DLVII-J Four-Port Serial Interface

J3 is the console interface. It is set up like the DLVII-F except that the baud rate is selected at 300.

J0 through J2 are additional ports. Their addresses and other parameters can be found in Section 2 of the Memory and Peripherals Handbook.

#### 3.2.1 FRONT PANEL & COVER REMOVAL

The front panel on the MF-211 is easily removable, allowing quick access to the card cage. A sliding clip is located on the far side of each of the two chassis flanges which allow release of the front panel. Raise these clips with a finger or screwdriver and pull off the panel. All cards can now be removed or installed. To replace the panel, it is necessary to align the panel's four guide posts to four holes in the chassis flanges. Push the panel on. Softly rap each side of the panel with your hand, and then lower the two locking clips. The top cover should be on before you attempt to remove or install the front panel.

The top cover is removed by unscrewing nine screws along the top edge of the two sides and rear. Access to the power supply is gained and the cables are now easily routed.

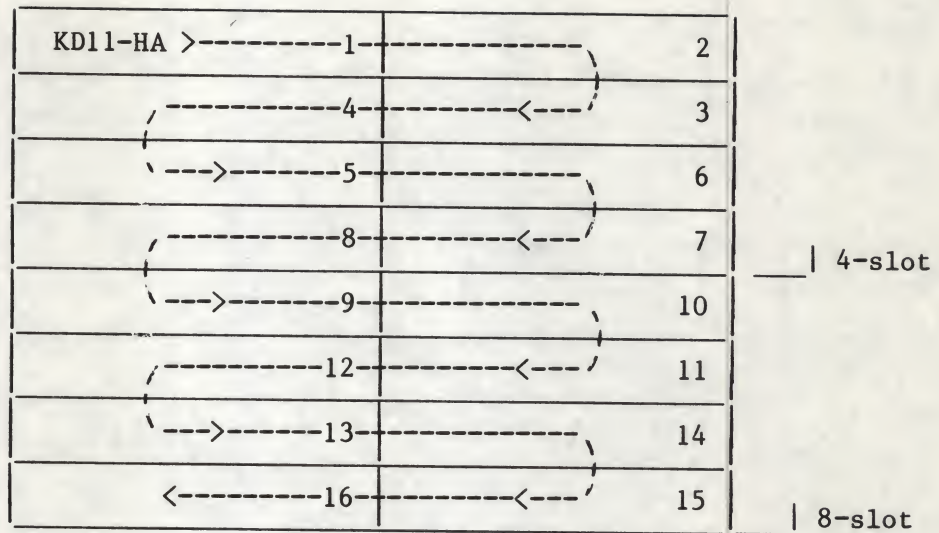
#### 3.2.2 MODULE PLACEMENT CONSIDERATIONS

The CPU board must occupy the first slot of the backplane (as shipped). Two signal lines which handle interrupt and DMA grants are broken by each slot on the backplane. This gives devices physically nearest the processor the highest interrupt priority. This system prohibits empty backplane slots between the processor and an interrupt-driven device interface. The backplane-determined priority levels are shown on the diagram following for both four- and eight-slot backplanes.

In general, devices requiring time-critical interrupt service, such as high speed modems which will lose data if it is not processed before the next character is received, should be placed closer to the CPU than devices which operate with low speeds or buffers. Memory and other devices which never require interrupt service may be placed anywhere.







PRIORITY SEQUENCE MAP

### 3.2.3 MODULE INSERTION

Insert modules along the card edge guides. Apply force to the handles when card edges are lined up with backplane slots. Considerable force may be required to seat the card; make sure the card fingers and corresponding backplane connectors are properly aligned. Never apply enough force to distort or bend the card's basic structure.

### 3.2.4 CABLING

All cables should be brought out through the rear of the chassis. The vertical slot in the top right rear of the chassis is for cables. See the instructions in the Handbook for each module, or consult the manufacturer's data sheet if you are unsure which cable to use for a given device.

If using the unit in a table-top configuration, skip Section 3.3.





### 3.3 RACK MOUNTING

First, separate both slide sections into two pieces by pulling the innermost piece out past the mounting flanges. It is necessary to push in the release buttons to accomplish this.

The two larger slide sections (with flange) should be mounted onto the cabinet's vertical rails. In order to fit the MF-211 into a 10-1/2" section, screw the bottom slot of the flange into the 13th hole above the top edge of any equipment lower in the rack. (The tapped retainer plate is supplied for cabinets without tapped holes.)

The two right-angle brackets are for attaching the rear of the slides to the cabinet. First, mount these brackets in the same way that the front flanges of the slides were mounted. Use two 10-32 screws to mount the brackets onto the vertical rails. If you have the three section slides, pull out the two middle sections from the just-installed slides, until they lock in place.

Mount the rear slide section to these brackets, again using 10-32 screws. Mount the inside slide section to the MF-211 cabinet, again using 10-32 screws and lockwashers. The spring buttons should be in the back of the MF-211 cabinet and facing outward.

#### **WARNING**

THE MF-211 IS QUITE HEAVY AND COULD  
TOPPLE THE CABINET WHEN IT IS IN ITS  
EXTENDED POSITION.

To slide the MF-211 into the cabinet, carefully lift the MF-211 and mate the slide sections. After pushing a short distance, the safety catch must be pressed in to allow the unit to travel further. Again, the safety catch must be pressed in to slide the MF-211 completely into the cabinet. Once properly installed into a cabinet on its safety-lock slides, the MF-211 can be easily pulled out part-way for most service or inspection access. To fully remove the device from its cabinet enclosure, the spring-loaded safety buttons or stops on each slide must be depressed until they pass the mating holes contained in the other portion of the slide.

2000-2001

2001-2002

2002-2003

2003-2004

2004-2005

2005-2006

2006-2007

2007-2008

2008-2009

2009-2010

2010-2011

2011-2012

2012-2013

2013-2014

2014-2015

2015-2016

2016-2017

2017-2018

2018-2019

2019-2020



## Section 4

### INSTRUCTIONS FOR USE

#### 4.1 DIFFERENCES BETWEEN MF-211 AND DEC 11V03-L

Instructions for use of the MF-211 system are identical to those given in Section 2 of the Handbook for operation of the LSI-11 and RXV-11, noting the following differences and options:

- 1) The bootstrap routine starting at location 773000 is provided by the FC-202 card; there is no REV-11 or BDV-11 module installed in the system.
- 2) Front panel indicators and controls are as described below.
- 3) The standard console device configuration (DLV-11F or DLV-11J has FEH (framing error halt) installed) allows entry to ODT by use of the BREAK key.

If you have not used floppy disk media before, please Section 4.5 and following on the handling of diskettes before using the system.

#### 4.2 FRONT PANEL CONTROLS

##### Power Switch

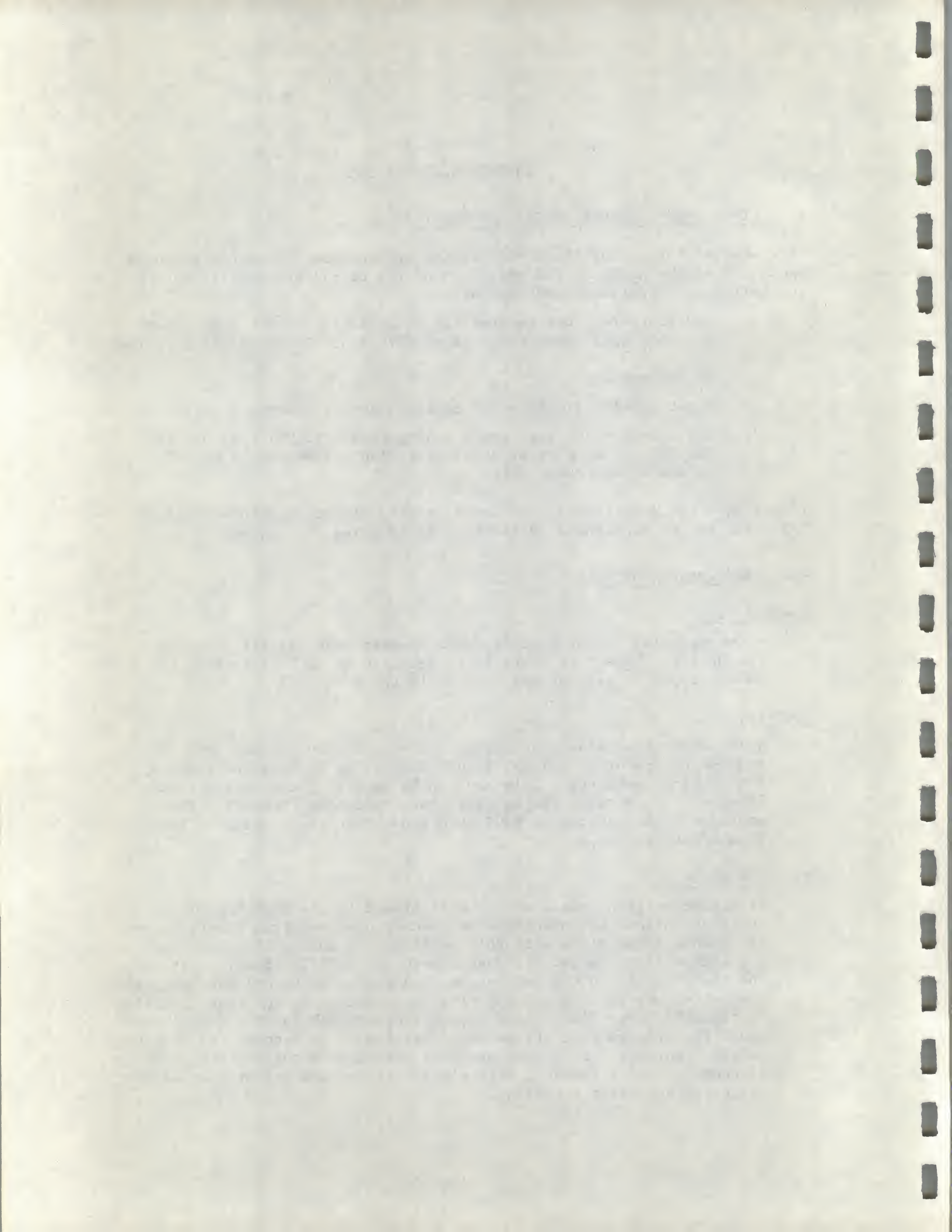
A two-position rocker style circuit breaker controls all power to the MF-211. Note that there is no separate AC or DC switch on the power supply on rear of the unit as in the PDP-11/03

##### BOOT Key

This momentary contact, spring return switch when pressed down causes the system to initialize all devices on the bus and execute the power-up sequence. This key can be used to recover from system "crashes" or to reset the hardware when executing from ODT. The response of the system to BOOT is dependent on the setting of the ENABLE/HALT switch.

##### ENABLE/HALT Switch

This two-position toggle switch when placed in the ENABLE (up) position, allows the processor to execute programs from memory. If an INIT takes place with this setting, the automatic bootstrap sequence will be executed. When placed in the HALT (down) position, the processor is in the halt state, and executes the ODT microprogram. The switch may be used to stop program execution at any time by moving it from ENABLE to HALT. Note that moving it back to ENABLE will not cause the program to continue until you issue the proceed (P) command to ODT. Further, if the processor is halted with this switch, the proceed or go (G) commands will simply display the new program counter value and not start execution.





## LTC Switch

The LTC (Line Time Clock) switch is a two-position toggle switch for enabling and disabling line time clock interrupts. When in the OFF (down) position, clock interrupts will not occur. It is necessary to switch the LTC OFF to run some programs, notably the CZQXAKO XXDP diagnostics, which cannot handle clock interrupts. The switch must be ON (up) for normal operation of RT-11 and similar systems which use the LTC as a system clock.

## 4.3 BOOTSTRAPPING THE SYSTEM

NOTE: The MF-211 will boot only double density encoded diskettes.

With a system disk installed in drive 0, and the ENABLE/HALT switch set to ENABLE, the system will be booted on power up or whenever the BOOT key is pressed. If the LTC is OFF, the system may be bootstrapped from ODT by typing:

@173000G

(Note: user input is underlined)

The LTC is switched OFF to disable interrupts before the monitor is installed to handle them. Pressing BOOT while in the HALT state will also provide protection from this problem.

## 4.4 INDICATORS

### RUN

This lamp indicates the processor state. When executing from program memory, the lamp is lighted. It is not lighted when in the HALT state. If the RUN lamp goes off while the processor is ENABLED and running, it generally indicates that a software "crash" has occurred or that the wait instruction is being executed. Note that the lamp provides an indication of the HALT state when switching from HALT to ENABLE and that it will come on when a valid proceed or go command is issued. Some flicker of the lamp when executing an INIT or power-up is normal.

### DC OK

This lamp should follow the on/off setting of the power switch. If the system will not come up and this lamp is off, a power failure is indicated.

## 4.5 DISKETTES

Diskettes must be treated with care to prolong diskette life and prevent damaging the sensitive recording surface. In addition we have found that not all of the media available is of good quality.

We strongly recommend that only the media listed below be used. This media has been extensively tested by Shugart, over many sample lots, and has been found to be of good quality. CRDS will only respond to complaints regarding the reliability of data stored on diskettes approved by Shugart.

Dear Sir,  
I have the honor to acknowledge the receipt of your letter of the 10th inst. in relation to the matter of the

above mentioned case, and in reply to inform you that the same has been forwarded to the proper authorities for their consideration.

I am, Sir, very respectfully,  
Your obedient servant,  
J. H. [Signature]

Enclosed for you are the documents referred to in your letter of the 10th inst. and also a copy of the report of the

committee on the subject, which may be of some service to you in the further prosecution of the matter.

I am, Sir, very respectfully,  
Your obedient servant,  
J. H. [Signature]



#### 4.5 DISKETTES (continued)

	<u>IBM</u>	<u>Dysan</u>	<u>Verbatim</u>	<u>Maxell</u>
Single Density	Diskette 1	3740S	FD34-9000	FD-3200S
Double Density	-	3740D	FD34-8000	-

If the user purchases single density media, it will require no formatting whatsoever for single density use. The single density media may also be used for double density operation by formatting double density data fields onto the disk as described in Sections 5.4.5.1 and 7.5. We do not recommend this, however. When double density media is purchased, the media has been certified for double density use and is often given a superior oxide coating. It does not, however, have either the appropriate headers or data fields preformatted on the disk (DEC and IBM double density formats are completely different). This problem can be overcome by formatting headers onto the disk as described in Section 5.4.5.2 and then writing data fields onto the disk by either of two methods, described in Sections 5.4.5.1 and 7.5.

##### 4.5.1 DISKETTE CARE

The following rules should be observed in diskette handling:

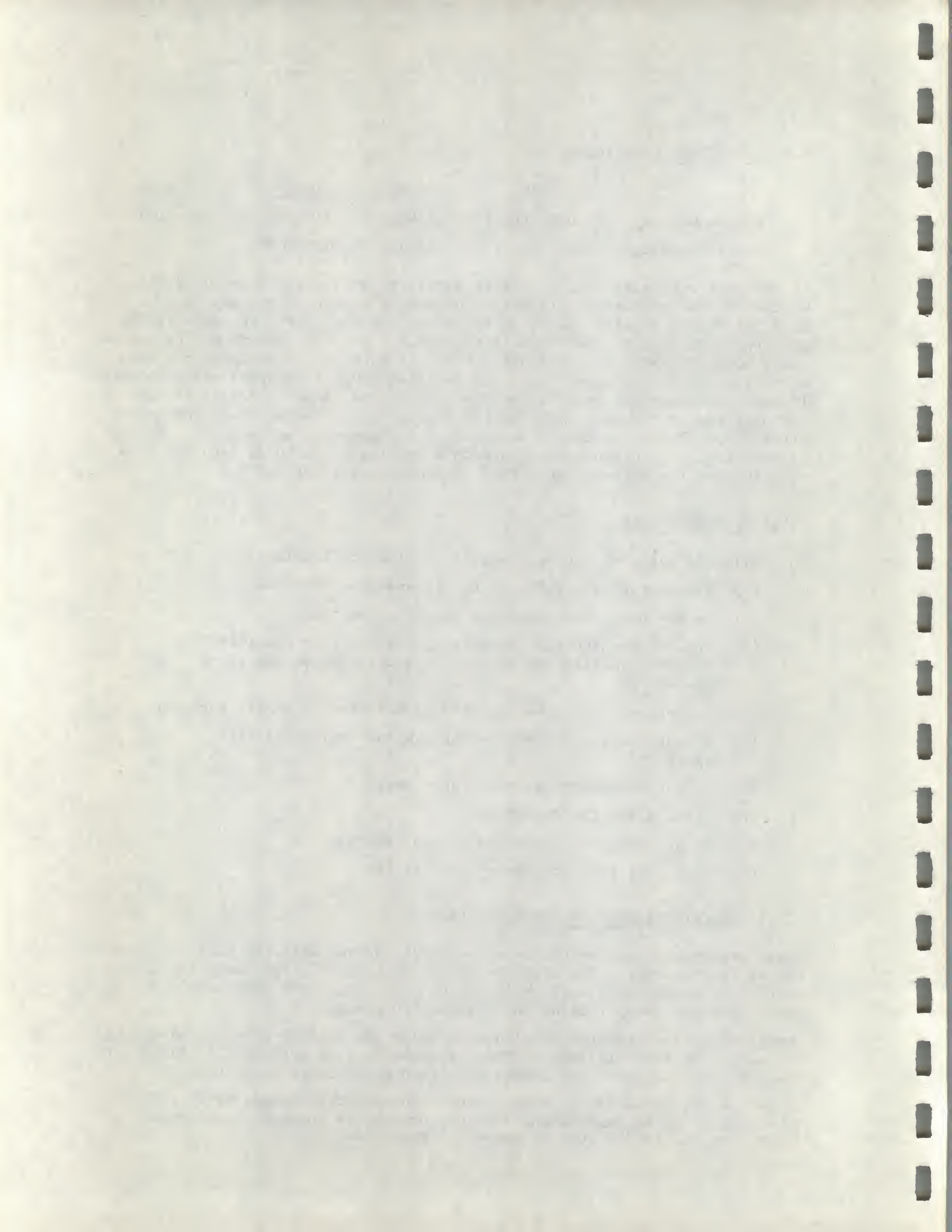
- (1) Always return a diskette to its envelope after use.
- (2) Do not place any object on top of diskettes.
- (3) Observe the storage temperature and humidity specifications of the diskettes and preferably store them at operating conditions.
- (4) Do not write on labels on the jacket above diskette surface.
- (5) Do not touch the diskette through the oval read/write aperture.
- (6) Do not store diskettes in dusty areas.
- (7) Never clean the diskette.
- (8) Never expose to prolonged heat or sunlight.
- (9) Keep away from strong magnetic fields.

##### 4.5.2 DISKETTE INSERTION AND EXTRACTION

Diskettes should be inserted into the MF-211 drives with the label up and facing the operator. The diskette should be inserted fully into the drive unit it is stopped and a click is heard. The long black door handle may now be pressed down, locking the diskette in place.

The diskette is extracted by simply pressing the black button containing the red LED. The door will pop up and the diskette will pop out. It may now be removed from the drive and placed back into its storage envelope.

Diskettes may be inserted or extracted with either the power on or off. They should not be removed while in use or anytime the red activity LED is on, nor should the door be opened at this time.





#### 4.5.3 WRITE-PROTECT DETECTOR

A photocell and LED detect the presence or absence of a write-protect hole on the diskette. A diskette without a write-protect hole (standard IBM and DECK supplied diskettes) will not be write-protected. However, placing a hole in the diskette as shown in Figure 4-1 will protect the diskette from being inadvertently written on. Covering this hole with foil tape will again allow the disk to be written on. Avoid write-protecting an RT-11 system disk.

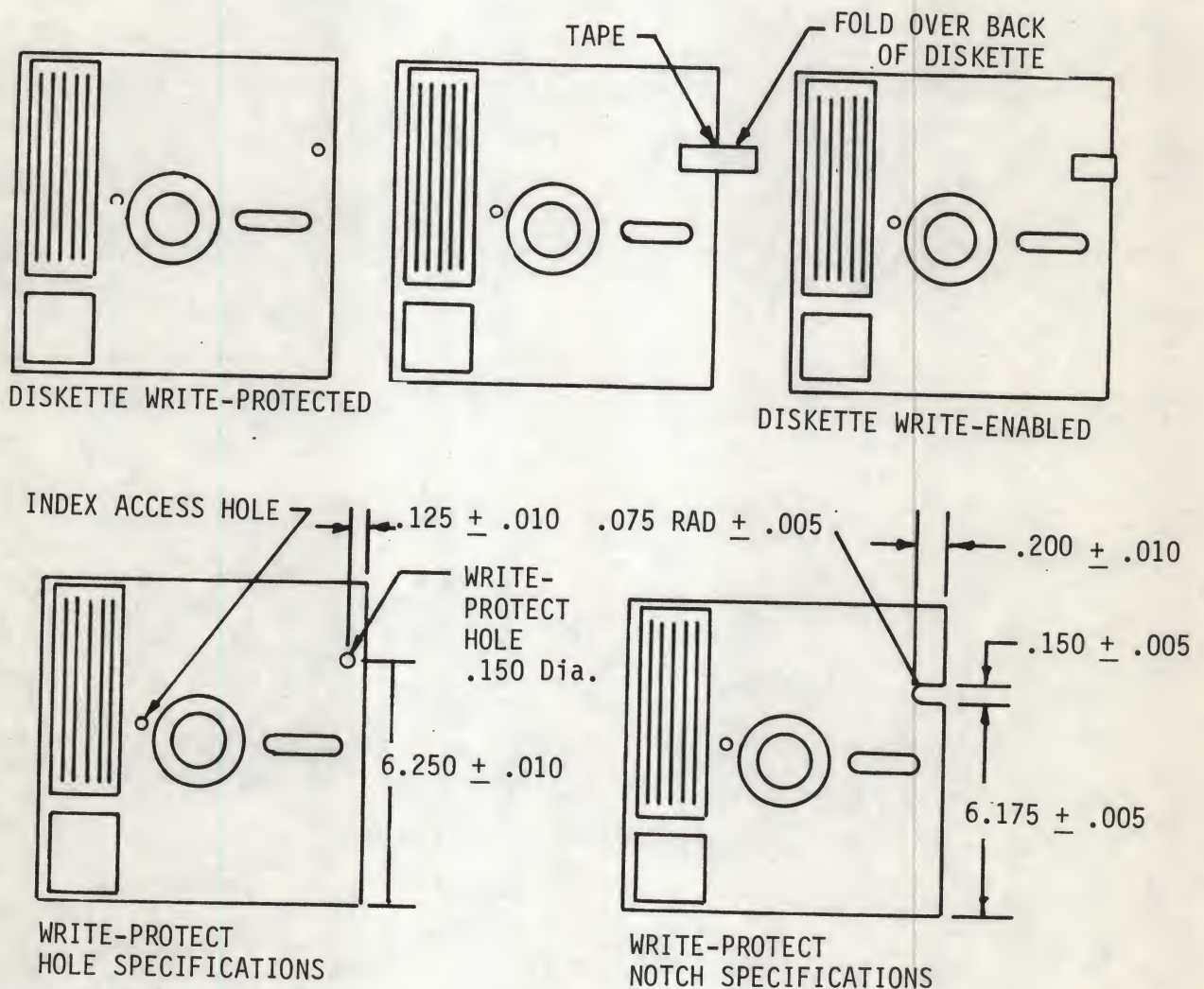


FIGURE 4-1





## Section 5

### STANDARD INSTRUCTION SET

#### 5.1 GENERAL

Program control of the FD-211 is accomplished by the proper manipulation of two device registers in the FD-211. The first of these two registers, the RXCS serves to pass control information from the CPU to the FD-211 and to report status and error information from the FD-211 to the CPU. The second register, the RXDB, transfers additional control and status information between the CPU and the FD-211. The information that is present in the RXDB at any given time is a function of the FD-211 operation that is in progress at that time.

Data transfers both to and from the diskette are always one complete sector (128 (SD) or 256 (DD) eight bit bytes) per transfer command. Partial sector transfers are not accommodated by the FD-211.

The FD-211 contains a read/write data buffer of 256 bytes. During write operations, this buffer is first loaded under a DMA command (fill) and then a write command is issued which transfers the contents of the buffer to the diskette. During read operations the read instruction is issued and the information from the proper sector and track is read into the buffer. After the buffer is full, the contents of the buffer are read out by a DMA command (EMPTY).

#### 5.2 REGISTER AND VECTOR ADDRESSES

The normal address assignments for the FD-211 device registers and the interrupt vector address are as follows:

<u>Function</u>	<u>Address</u>
RXCS	777170
RXDB	777172
Interrupt Vector	264

#### 5.3 FD-211 REGISTER DESCRIPTION

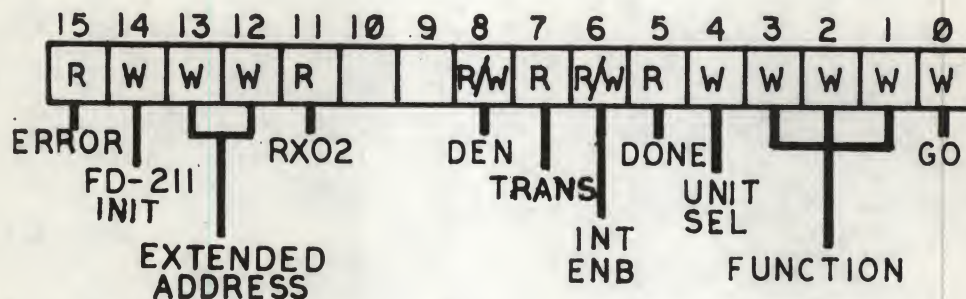
The 2 registers listed above are used to transfer both command and status information between the CPU and the FD-211. The first of these registers is used to initiate commands and indicate certain status information. The second of these registers has 5 different uses; which one it serves is determined by the protocol of the operation being performed. These five functions are: (1) to transfer the sector address for a read or write operation, (2) to transfer the track address for a read or write operation, (3) to indicate certain common error conditions, (4) to transfer the word count for a DMA command, and (5) to transfer the starting address of a DMA command.





### 5.3.1 RXCS COMMAND AND STATUS REGISTER (777170)

Commands to the FD-211 are initiated by loading this register with the proper function code accompanied by the "Go" bit provided that the FD-211 is not busy when the command is issued. The operation codes and bit assignments for the RXCS are shown below. Bits designated W are write only, bits designated R are read only, and bits designated R/W can be both written and read by the CPU.



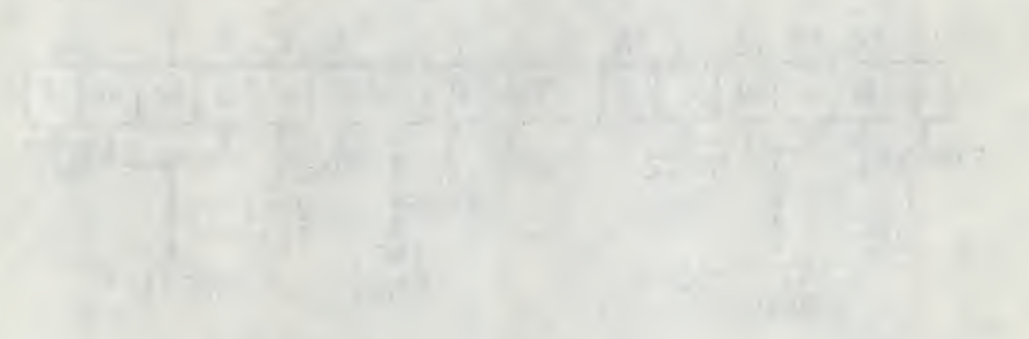
#### Binary Function Code

000	Fill Buffer
001	Empty Buffer
010	Write A Sector
011	Read A Sector
100	Format Functions
101	Read Status
110	Write Deleted Data Sector
111	Read the Error Register

FIGURE 5-1

RXCS Bit Assignments and Function Codes.

The first part of the paper is devoted to a discussion of the  
 general principles of the theory of the structure of the  
 crystal lattice. It is shown that the structure of the  
 crystal lattice is determined by the nature of the  
 forces acting between the atoms.



The second part of the paper is devoted to a discussion of the  
 properties of the crystal lattice. It is shown that the  
 properties of the crystal lattice are determined by the  
 nature of the forces acting between the atoms.

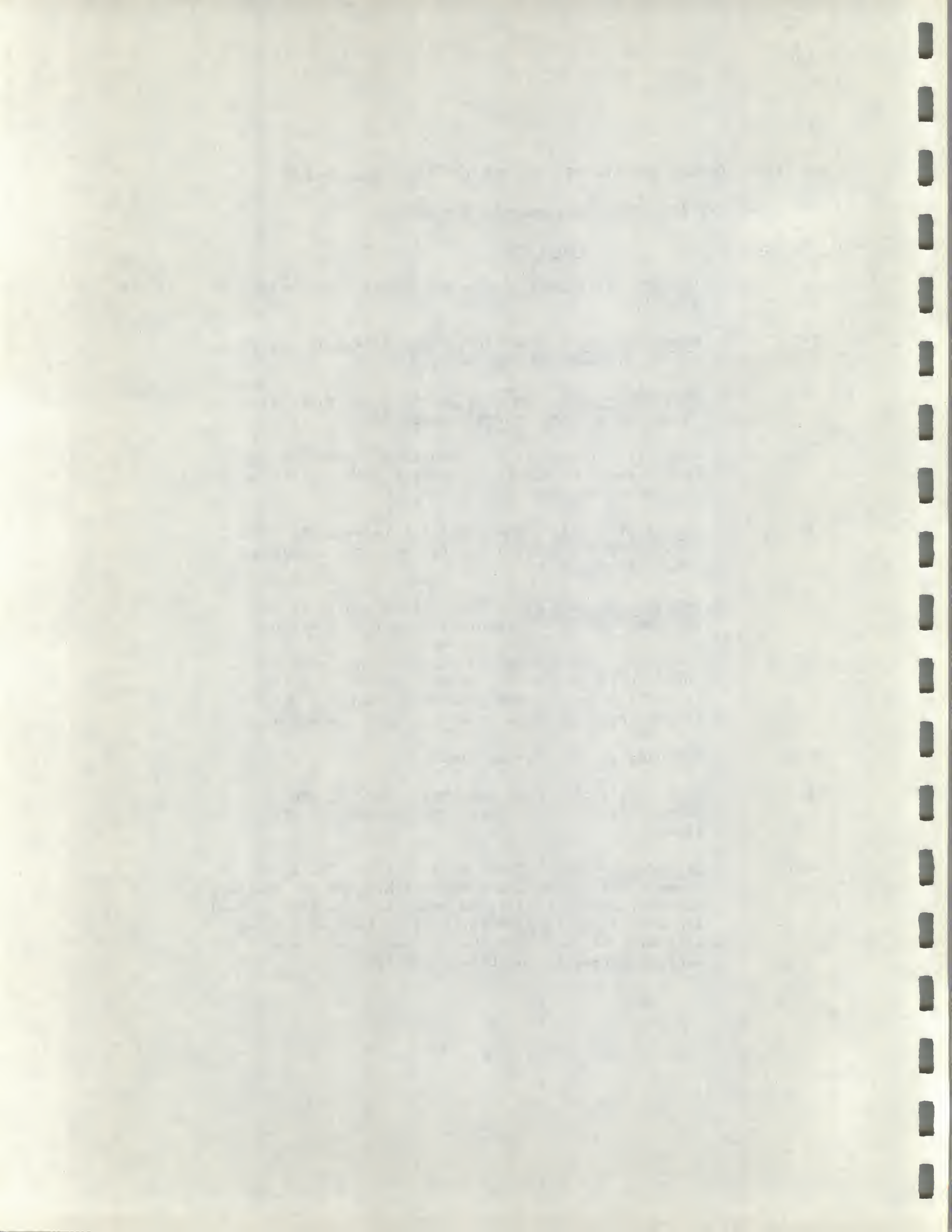
The third part of the paper is devoted to a discussion of the  
 properties of the crystal lattice. It is shown that the  
 properties of the crystal lattice are determined by the  
 nature of the forces acting between the atoms.



### 5.3.1 RXCS COMMAND AND STATUS REGISTER (777170) (continued)

#### Description of Bit Assignments for RXCS

<u>Bit Number</u>	<u>Function</u>
0	<u>Go bit.</u> Initiates the selected operation in the FD-211.
1-3	<u>Function code.</u> These three bits select the operation to be performed by the FD-211.
4	<u>Unit Select Bit.</u> Selects which of two disk drives is to execute the selected operation.
5	<u>Done Bit.</u> Indicates the completion of an operation. If Interrupt Enable is set when the Done bit is asserted, a program interrupt will occur.
6	<u>Interrupt Enable.</u> When this bit is set, the FD-211 will cause a program interrupt upon the completion of an operation.
7	<u>Transfer Request Bit.</u> This bit indicates to the CPU that the FD-211 requires data from the CPU.
8	<u>Density.</u> This bit determines the density of the function to be executed when a command is given. It is valid only when the Done bit is set, at which time it indicates the density of the last command executed.
9-10	Not Used at the Present Time.
11	<u>RX02.</u> This bit indicates that a FD-211, DMA Dual Density System is on-line. It is valid at all times.
12-13	<u>Extended Address.</u> These bits determine on a DMA command the higher order address bits of the starting address. These bits allow expansion above the normal 32K addressing to 128K for this peripheral. These bits will be used with the introduction of new microcomputers to the LSI-11 family.





### 5.3.1 RXCS COMMAND AND STATUS REGISTER (777170) (continued)

#### Description of Bit Assignments for RXCS

<u>Bit Number</u>	<u>Function</u>
14	<p><u>FD-211 Initialize.</u> The FD-211 can be selectively initialized by setting this bit in the RXCS. Other devices connected to the system bus are not affected. The effects of setting this bit are the same as a bus init signal. The FD-211 will:</p> <ul style="list-style-type: none"> <li>(a) Reset Done Bit.</li> <li>(b) Move the head of drive 1 to track 0 (LED on drive will flash).</li> <li>(c) Move the head of drive 0 to track 0 (LED on drive will flash).</li> <li>(d) FD-211 clears the error and status register.</li> <li>(e) FD-211 sets Initialize Done.</li> <li>(f) FD-211 sets RXES bit 7 (DRV RDY) if drive 0 is ready.</li> <li>(g) Sector 1 of track 1 of the diskette on drive 0 is read into the buffer.</li> </ul>
15	<p><u>Error.</u> This bit indicates an error of some type occurred during a command. It is cleared by a new command or an initialize.</p>

### 5.3.2 RXDB REGISTER (777172)

As mentioned in paragraph 5.3, this register has five distinct functions determined by the protocol of the operation. Section 5-4 details this protocol. The RXDB can be read only when the FD-211 is not executing a command, the RXDB can be written only when the TR (transfer) bit (RXCS Bit 7) is set.

#### 5.3.2.1 SECTOR ADDRESS REGISTER

This register indicates which of 26 sectors, numbered 1 through 26 (32 octal), are to be used in a read or write command.

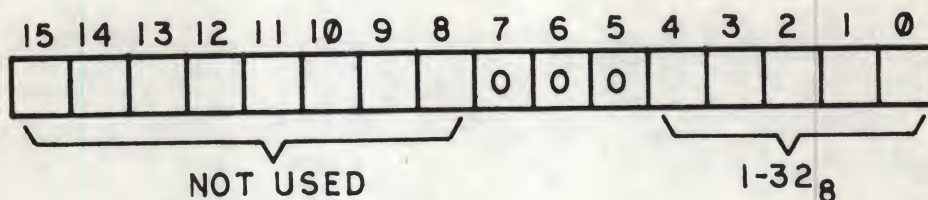


FIGURE 5-3  
Sector Address Format

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### 5.3.2.2 TRACK ADDRESS REGISTER

This register indicates which of 77 tracks, numbered 0 through 76 (114 octal), are to be used in a read or write operation.

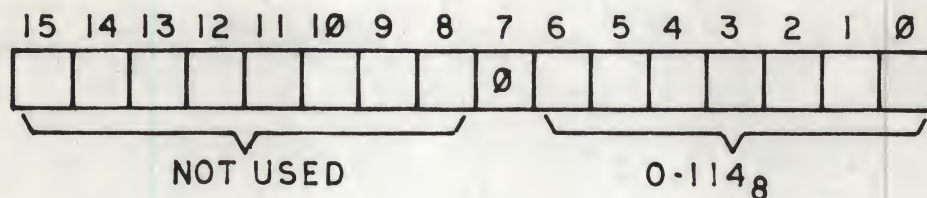


FIGURE 5-4  
Track Address Format

### 5.3.2.3 ERROR AND STATUS REGISTER

This register contains certain error and status flags for the drive selected by the unit select bit. It is always available at the completion of an operation and may also be read by the read status function.

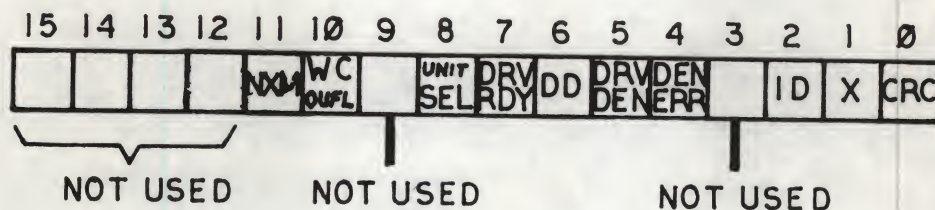


FIGURE 5-5  
Error and Status Format

Bit No.	Code	Description
0	CRC	A cyclic redundancy error has occurred in a read operation.
1	X	Not used.
2	ID	Initialize DONE - indicates that an initialization took place. This can be caused by a power failure, programming or a bus signal.





### 5.3.2.3 ERROR AND STATUS REGISTER (continued)

<u>Bit No.</u>	<u>Code</u>	<u>Description</u>
3	X	Not used.
4	DEN EER	Density error. Indicates that the density of a read or write command was different than the density of the diskette in the selected drive. The read or write operation is terminated.
5	DRV DEN	This bit indicates the density of the diskette in the drive selected by a read or write operation.
6	DD	A deleted data mark was found during a read or the last command issued was a write deleted data command.
7	DRV RDY	This bit indicates that the selected drive is ready and has a diskette installed correctly. It is only valid when retrieved after a read status function or after an initialize when it indicates the status of drive 0.
8	UNIT SEL	This bit indicates which drive was selected by the last read or write operation.
9		Not Used.
10	WC OVFL	Wordcount overflow indicates that the wordcount specified by a fill or empty command was greater than sector size for the density selected. The operation is terminated.
11	NXM	Non-existent memory error. This bit is set if during a DMA transfer, the controller did not receive a reply when it attempted to read or write memory. The operation is terminated.

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SIR:  
I have the honor to acknowledge the receipt of your letter of the 10th inst.  
and in reply to inform you that the same has been forwarded to the  
proper authorities for their consideration. I am, Sir, very respectfully,  
Yours truly,  
J. R. OPPENHEIMER  
Professor of Physics  
The University of Chicago  
Chicago, Illinois



#### 5.3.2.4 WORD COUNT REGISTER

This register indicates how many words are to be transferred in a Fill Buffer or Empty Buffer operation. The maximum word count is  $128_{10}$  for a double density sector, and  $64_{10}$  for a single density sector. This write-only register is loaded with the actual word count and not the 2's complement.

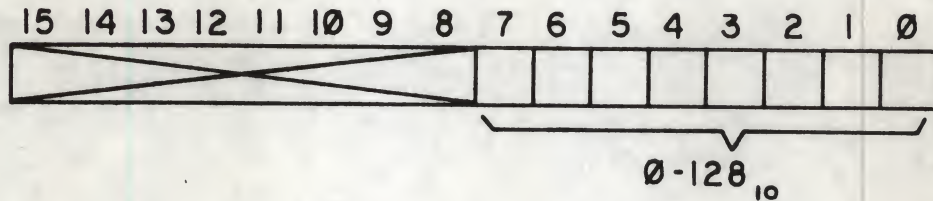


FIGURE 5-6  
Word Count Format

#### 5.3.2.5 BUS ADDRESS REGISTER

This 16-bit, write-only register indicates the starting bus address of data transferred during Fill Buffer, Empty Buffer, and Read Error Register operations.

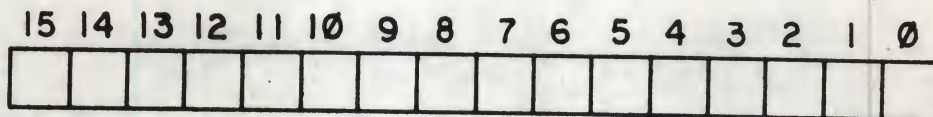


FIGURE 5-7  
Bus Address Format

and a ... ..  
 ... ..  
 ... ..  
 ... ..

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20

... ..  
 ... ..  
 ... ..  
 ... ..  
 ... ..  
 ... ..  
 ... ..  
 ... ..  
 ... ..  
 ... ..

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20

... ..  
 ... ..



#### 5.4 COMMAND FUNCTIONS AND THEIR PROTOCOL

The function codes listed in Figure 3-1 are described in detail below. The specified protocol of each function must be observed or data loss may result.

##### 5.4.1 FILL BUFFER FUNCTION (000)

This function is used to fill the FD-211 internal buffer with data from the memory. The contents of the buffer are usually written onto the disk after completion of this operation. The following procedure is used in executing this function:

- (1) Store function code 000 and the Go bit into the RXCS (777172).
- (2) Check that the TR bit in the RXCS is on.
- (3) Deposit the wordcount in the RXDB register (777172).  
This number will be 100 (Octal) for a full single density sector and 200 (Octal) for a full double density sector. Wordcounts less than these numbers are permissible for partial sector transfers. The remainder of the buffer will be set to 0.
- (4) Again, check that the TR bit in the RXCS is on.
- (5) Deposit the starting address in the RXDB register.  
This address may be anywhere in the 30K memory address range of the LSI-11. For addressing above 32K, set the extended address bits in the RXCS during step 1 (see Section 5.3.1).
- (6) The controller will perform DMA read operations on memory to obtain up to 128 16-bit words of memory (double density or up to 64 words single density).
- (7) The Done bit will then be set and the function is complete.

##### 5.4.2 EMPTY BUFFER ROUTINE (001)

This function is used to empty the FD-211 internal buffer into the CPU.

This function is usually performed after the completion of a read operation. The following procedure is used in executing this function.

- (1) Store function code 001 and the Go bit into RXCS.
- (2) Check that the TR bit in the RXCS is on.
- (3) Deposit the wordcount in the RXDB register (777172).  
This number will be 100 (octal) for a full single density sector and 200 (octal) for a full double density sector. Wordcounts less than these numbers are permissible for partial sector transfers.
- (4) Again, check that the TR bit in the RXCS is on.
- (5) Deposit the starting address in the RXDB register. This address may be anywhere in the 30K memory address range of the LSI-11. For addressing above 32K, set the extended address bits in during step 1 (see Section 5.3.1).

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#### 5.4.2 EMPTY BUFFER ROUTINE (001) (continued)

- (6) The controller will perform DMA write operations on memory to unload up to 128 16-bit words (double density or up to 64 words single density).
- (7) The Done bit will then be set and the operation is complete.

#### 5.4.3 WRITE SECTOR FUNCTION (010)

This function is used to write the contents of the FD-211's internal buffer onto the disk. The following procedure is used in executing this instruction.

- (1) Store function code 010 and the Go bit into RXCS. The setting of the density bit will determine if a single or double density operation is to be performed.
- (2) Check that the TR bit in the RXCS is on.
- (3) Now transfer the sector address to the FD-211 via the RXDB.
- (4) Check that the TR bit in the RXCS is on.
- (5) Now transfer the track address to the FD-211 via the RXDB.
- (6) A write operation will now occur if no error conditions appear. Write protection is sensed and the operation terminated if set. Any track seeking required now takes place. If the head of the selected unit was loaded at the time the operation was initiated, then there can be no danger of a density error and the write operation is performed. If the head was unloaded at the time the operation was initiated the diskette may have been changed. The controller, therefore, performs a quick density check of the next sector to come, lasting on the average only 4 to 5 milliseconds. If the density of the operation agrees with the density of the diskette, the write operation is performed.
- (7) On completion of the operation, the Done bit will be set and the RXDB will contain the error and status register.

#### 5.4.4 READ SECTOR FUNCTION (011)

This function is used to read a diskette sector into the FD-211's internal buffer. The procedure followed by this function is identical to that of the write sector function described in the previous paragraph. After waiting for the TR bit each time, the sector address and then the track address are deposited into the RXDB, location 777172. The function is then executed.

#### 5.4.5 FORMAT FUNCTION (100)

Two separate and distinct format functions are provided with the FD-211 system.





#### 5.4.5.1 FORMAT DATA FIELDS

The first of these is identical to DEC's "Set Media Density" operation. It rewrites the data fields of all sectors on a diskette with either single or double density marks, as specified by bit 8 (density bit) in the command register. These marks are in fact always rewritten during any write operation but the write operation does not allow the user to write a mark with a density different from other marks on the diskette (see write function, Section 5.4.3). This is to prevent diverse densities on one diskette.

Therefore, in order to change the density of a diskette, all data field marks must be rewritten to the new density. This operation will destroy all data on the diskette, leaving data fields of all zeros. The location of these data field marks is shown in figure 2-3.

The format function can be performed by using the format command under RT-11 (see Section 7.5) or directly through the use of ODT. This is done by the following sequence of operations:

- (1) Store function code 100, the Go bit, the density bit (0 for single density, 1 for double density) and the unit select bit into RXCS. The possible combinations of bits are listed below.

Format	Code
Unit 0, single density	11
Unit 0, double density	411
Unit 1, single density	31
Unit 1, double density	431

- (2) Wait for the trans bit to be set.
- (3) Deposit the key word 111 (octal) into the RXDB. This key word is to help prevent accidental initiation of this function.
- (4) The FD-211 will start the selected drive at track 0, sector 1 and rewrite all sectors through track 76, sector 26. If the operation is interrupted at any time during the 25 seconds needed to complete this operation, the operation must be restarted and allowed to complete, otherwise an "illegal" diskette has been created.
- (5) If the operation does not complete normally, and ends with the error flag on, a difficulty was encountered in reading the headers of the sectors. This may be due to defective media. The user may attempt to rewrite these headers using the instructions given in Section 5.4.5.2
- (6) If the operation completes successfully, the Done bit will be set and no error condition will be flagged.





#### 5.4.5.2 FORMAT HEADERS

Although it is possible to buy diskettes preformatted with the standard IBM 3740 headers, these diskettes are intended for single density, not double density operation. These diskettes have not been certified for double density, and in some cases they lack the superior oxide coating that diskette manufacturers place on double density media. It is therefore suggested that the user purchase double-density certified media. Because no other mainframe manufacturer besides DEC uses a single density header format for double density operation, at the present time diskette suppliers do not supply double density media with formats compatible with the FD-211 and the RX02.

In case of the RX02, this media is unusable. However, the FD-211 provides a function to write headers. These headers are never written by the RX02 and only written by the FD-211 during this format operation.

This format function cannot be activated from RT-11 but can easily be activated through ODT.

- (1) Store the function code 100, the Go bit and the unit select bit into RXCS.

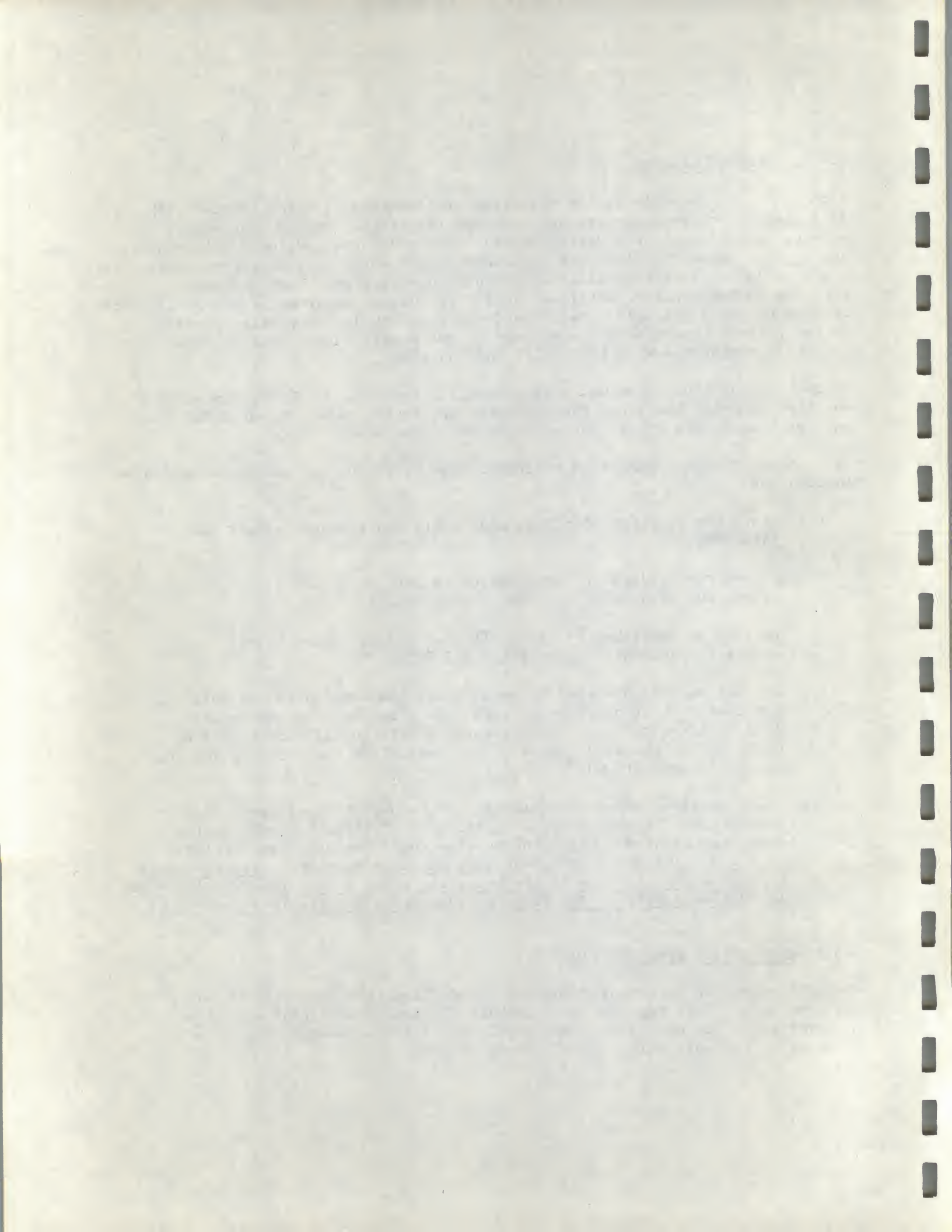
Format the headers of the diskette in unit 0: 11  
Format the headers of the diskette in Unit 1: 31

This is accomplished by typing 777170/ and after the LSI-11 states the contents, type 11 (or 31) <CR>.

- (2) The key word is now used to avoid accidental initiation of this function. It also differentiates this function from the format data fields function. The key work is 1111 (octal) and should be deposited in the RXDB. Type 777172/ and after the LSI-11 gives the contents type 1111 <CR>.
- (3) This operation takes approximately 25 seconds to complete. If interrupted, it must be reinitiated or an "illegal" diskette will have been created. This routine does not format the data fields. At the completion of this function, the user must write either single or double density data fields using the other format function described in Section 5.4.5.1. The disk is unusable until this is accomplished.

#### 5.4.6 READ STATUS FUNCTION (101)

When this function is executed the error and status register will be loaded into the RXDB. This register will contain the same status generated from the last operation except that bit 7 will now indicate whether the drive selected by the unit select bit is ready or not.





#### 5.4.7 WRITE SECTOR WITH DELETED DATA FUNCTION (110)

This function is identical to the write sector function described in paragraph 5.4.3 except that a deleted data marks is written just before the start of the data field.

#### 5.4.8 READ ERROR CODE (111)

This function is used after an error occurs to determine the exact nature of the error and the contents of certain registers at the time the error occurred. It is initiated by the following sequence:

- (1) Deposit the Go bit and the function code 111 (17) into the RXCS.
- (2) Wait for the trans bit in the RXCS to set.
- (3) Deposit the starting address of an unused 4 word block in memory into the RXDB.
- (4) The FD-211 will now DMA the following words into memory (LSB = least significant byte, MSB = most significant byte):

Definitive error code	Word 0, LSB
Word count register	Word 0, MSB
Current track address of drive 0	Word 1, LSB
Current track address of drive 1	Word 1, MSB
Target track of command	Word 2, LSB
Target sector of command	Word 2, MSB

It should be noted that the word count register is only valid after DMA commands and that the target track and sector registers are only valid after disk I/O commands.

The definitive error codes given by the FD-211 are defined below:

Octal Code	Error Code Meaning
0010	Drive 0 failed to see home on Initialize.
0020	Drive 1 failed to see home on Initialize.
0100	Write protect violation attempted.
0120	A preamble could not be found or no ID mark found within allowable time span.
0150	The header track address of a good header does not compare with the desired track.
0160	Too many tries for header identification routine.
0170	Data AM not found in allotted time.
0200	CRC error on reading the sector from the disk.
0230	Word count overflow.
0240	Density error.
0250	Wrong key word for set media density command.





## Section 6

### SPECIAL FUNCTIONS: BOOTSTRAP AND SELF-TEST

The MF-211 has the ability to bootstrap system and diagnostic diskettes without the aid of a bootstrap card such as the REV-11 or the BDV-11.

#### 6.1 ENABLING AND DISABLING THE BOOTSTRAP

The bootstrap feature may be enabled or disabled by means of a jumper on the card as shown in Figure 6-1.

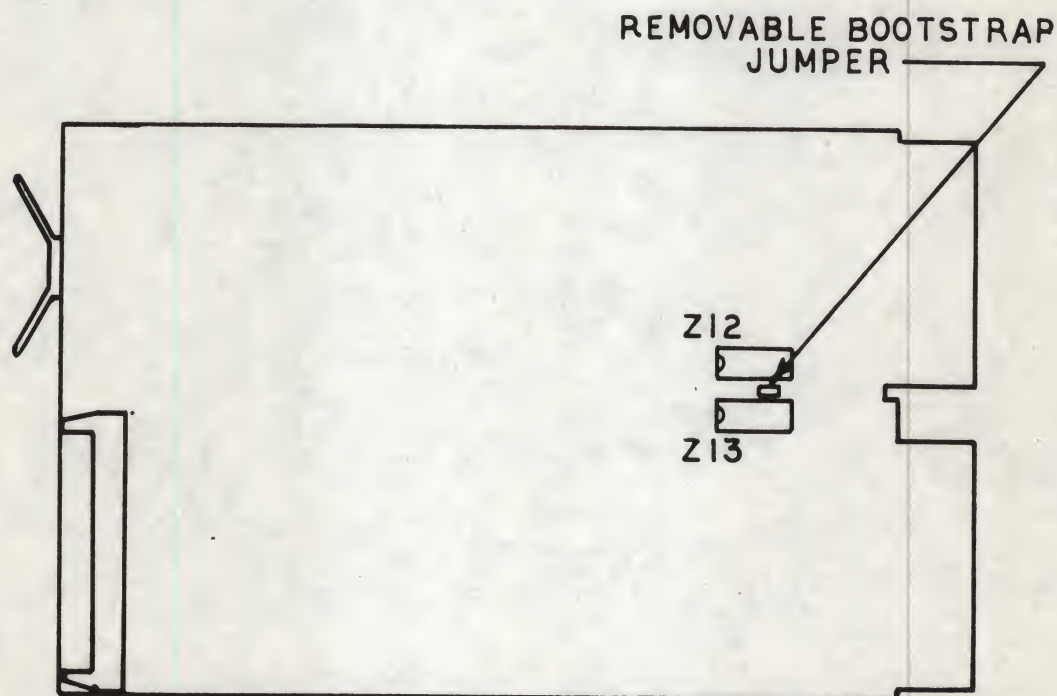


FIGURE 6-1

All cards are shipped with the jumper installed, that is, the boot enabled. If an REV-11, BDV-11, or other bootstrap card is used, the bootstrap must be disabled by removing the jumper. On cards whose serial number is between 1000 and 1099, this jumper is not available. These cards were shipped with the bootstrap enabled. If it is desired to disable this bootstrap, it is necessary to either:

- (1) Request a non-bootstrap ROM chip from CRDS (this chip replaces Z13), or
- (2) Remove Z13 from its socket and carefully bend pin 10 of this IC so that when the chip is replaced in its socket, pin 10 will not make contact.

Figure 1



The diagram illustrates the geometry of the structure, showing the relationship between the dimensions and the internal components. The dimensions are given in feet and inches.

The dimensions are as follows: the overall width is 10 feet, the overall height is 10 feet, and the internal dimensions are 6 feet by 6 feet. The internal dimensions are given in feet and inches.



## 6.2 USING THE BOOTSTRAP

The procedure is quite simple. The LSI-11 processor card is strapped on shipment to power up in mode 2, that is, when an init or power up occurs, the processor automatically starts execution at location 773000. The location of the jumper on your LSI-11 processor can be found in the Microcomputer Processors Manual.

## 6.3 HOW THE BOOTSTRAP FUNCTION WORKS

The MF-211 bootstrap function works differently than a standard ROM bootstrap. This feature utilizes the high speed microprocessor on the FC-202 controller card instead of a ROM.

The user may notice that if one attempts to read location 773000, it is found to be non-existent. The MF-211 only responds to this address immediately after a bus init. At that time it responds with instruction data that:

- (1) Clears processor register 0
- (2) Places the device address (177170) in register 1
- (3) Deposits 777 (PDP-11 jump to present location instruction) into location 0
- (4) Causes processor to jump to location 0
- (5) Reads sector 1, track 1 of drive 0 and DMA's this into locations 0 through 377
- (6) Reads sector 3, track 1 of drive 0 and DMA's this into location 400 through 777
- (7) DMA's location 0 with 240 (PDP-11 NOP instruction) freeing processor

## 6.4 SELF-TEST FUNCTION

This function may be used to both diagnose problems with the MF-211 system as well as certify that all sectors of a particular diskette are readable. When initiated, this function starts reading each sector of the diskette starting with track 0, sector 1 and ending with track 76, sector 26. If at any time a CRC or other error is encountered, this microcode routine will halt with the error and done bits set. If no error is found, a halt occurs after reading track 76, sector 26 and the done bit is set. The function is initiated in the following manner.

- (1) Store function code 100, the Go bit, the density bit (0 for single density, 1 for double density) and the unit select bit into RXCS. The possible combinations of bits are listed below.

Format	Code
Unit 0, single density	11
Unit 0, double density	411
Unit 1, single density	31
Unit 1, double density	431

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TO: THE DIRECTOR, NATIONAL BUREAU OF STANDARDS  
WASHINGTON, D. C. 20535

FROM: DR. J. H. DUNN, JR.  
DEPARTMENT OF CHEMISTRY  
UNIVERSITY OF CHICAGO

SUBJECT: ACRYLONITRILE  
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REFERENCE: J. H. DUNN, JR.,  
J. POLYMER SCI. PART A, 1, 1001 (1963)

REMARKS: This work was supported by the  
National Science Foundation, Grant No. 44400-  
A01.

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- (2) Wait for the trans bit to be set.
- (3) Deposit the key word 2111 (octal) into the RXDB.
- (4) The MF-211 will start the selected drive at track 0, sector 1 and read all sectors through track 76, sector 26.
- (5) If the operation does not complete normally, and ends with the error flag on, a difficulty was encountered in reading the headers of the sectors. This may be due to defective media.
- (6) If the operation completes successfully, the Done bit will be set and no error condition will be flagged.





## Section 7

### USE OF THE MF-211 WITH RT-11

The introduction of new products in the computer industry often brings questions from users on compatibility with previous equipment, software, and media. This product is no exception.

The MF-211 (and the RX02) is compatible with single density media but has a different instruction set than its predecessor, the MF-11 (and RX01). This has led to much confusion. The FD-211 allows the user access to all of his old single density programs, the ability to store twice as much data in double density mode, and the use of DMA to transfer data to and from the disk.

The FD-211 (and the RX02) does, however, require a different handler than the single density systems. This handler utilizes DMA to transfer data rather than using program-controlled data transfers. This handler is available in RT-11-V03B and later software revisions. From the point of view of the operating system, the FD-211 is a new device designated "DY". The single density system designation for floppy disk is "DX".

The new handler does have one unusual feature. It will read both single and double density disks without any need for the user to tell the system which density disk it is using. A difference in the format of the diskette's data field automatically informs the handler of the density of the disk. Both single and double density disks are designated "DY".

#### 7.1 GENERATION OF DY-COMPATIBLE RT-11 SYSTEM DISKS

In order to use RT-11 with the FD-211 (or the RX02), it is necessary to have or generate a system with a DY monitor built in rather than a DX monitor. The easiest option for the user is to obtain his RT-11 system on double density media. CRDS supplies such a diskette when RT-11 is purchased along with the MF-211. The system will then already have the DY monitor built in. The diskette can be placed in drive 0 and will boot with an init as described in Section 6.

Many users, however, have RT-11 system distribution media in single density format with a DX monitor built into the system. These diskettes have to be rebuilt to boot on an FD-211 (or RX02). In order to build a DY-based system, access to an MF-11, FD-11 or an RX01 is required. If none is available, either a DY-based monitor system diskette must be obtained or an FD-211 may be used in RX01 emulation mode as described in Section 8.

#### 7.2 CREATING A DY-BASED SYSTEM ON A DX-BASED SYSTEM

The DX-based system disk has a system monitor file on it: either DXMNSJ, DXMNFB, or DXMNXM. (It may have more than one of these, but you are only using one. If you don't know which one you are using, boot the system. The first thing printed on the terminal will be either RT-11SJ, RT-11FB, or RT-11XM. The last two letters of that are the same as the last two letters of the monitor you are using.) This system monitor file is written for use with single density systems.







## 7.2 CREATING A DY-BASED SYSTEM ON A DX-BASED SYSTEM (continued)

The system disk you are now using also has a bootstrap program on it. It is not accessible as a file (you won't see it in the directory, for instance), but it is there nonetheless. This bootstrap is also written for single density systems. Everything else on your system disk is compatible with double density systems (unless you have put something unusual on it).

To generate a DY-based system diskette, you must create a system disk identical to the first, except that it will have a version of the monitor and the bootstrap written for use on a double density system. (This new disk is still single density - it is not the one you will be using on your double density system, but is a step to creating that one.)

If a SYSGEN was done to create your current system disk, you must do another SYSGEN to create a new (still single density) system disk equivalent to the first. (If you don't know whether a SYSGEN was done, bring up the system. If the first thing it types out has an "(S)" in it (for example, RT-11SJ (S)V03-00), then SYSGEN was done.) While doing the SYSGEN, the program will ask you "What is the name of the system device?" Tell it DY. See the RT-11 SYSTEM GENERATION MANUAL for further details.

If a SYSGEN was not done to create your current system disk, that means that the monitor file was used just as it appeared on one of the distribution disks. Also on one of the distribution disks (disk 5/8, probably) is a version of the monitor written for double density systems. Its name is DYMNSJ if you are currently using DXMNSJ, and is DYMNFB if you are using DXMNFB. (DXMNXM is created with a SYSGEN.) To create the new (still single density) system disk, do the following:

Bring up your DX-based system in the usual way.

Insert a blank disk in drive 1 and initialize it:  
.INIT/NOQUERY DX1:

Copy SWAP.SYS (the most used file) onto it first:  
.COPY/SYS DX0:SWAP.SYS DX1:\*.\*

Prepare to copy the new monitor onto it:  
.R PIP

Replace the system disk in drive 0 with distribution disk 5/8 (the one with the double density monitor on it) and copy the monitor onto the new disk:

\*DX1:\*. \* = DX0:DYMNSJ.SYS/Y  
or  
\*DX1:\*. \* = DX0:DYMNFB.SYS/Y

Put the system disk back in drive 0 and return to the monitor  
\*↑C

Copy the rest of the system disk, excluding the old monitor:  
.COPY/SYS/EXCLUDE DX0:DXMNSJ.SYS DX1:\*. \*  
or  
.COPY/SYS/EXCLUDE DX0:DXMNFB.SYS DX1:\*. \*

Finally, install the new bootstrap:  
.COPY/BOOT DX1:DYMNSJ.SYS DX1:  
or  
.COPY/BOOT DX1:DYMNFB.SYS DX1:

If any patches had been made to DXMNSJ (or DXMNFB) they should also be made to DYMNSJ (or DYMNFB).







### 7.3 CREATING A DY-BASED DOUBLE DENSITY DISKETTE

The diskette created by the instructions in paragraph 7.1 is a DY-based single density system diskette. In order to create a double density DY-based system diskette, the single density diskette must be booted on the MF-211 system and copied to a double density diskette.

The single density DY-based system diskette is easily bootable if the user has a BDV-11 bootstrap card. The bootstrap function on the FD-211 will not bootstrap single density system diskettes. This is a feature that is really only required once, and then only if the user does not have a double density system diskette. Section 7.3.1 describes a method of booting a single density DY-based system diskette without the aid of a bootstrap. Those users with a bootstrap card should proceed to Section 7.4.

#### 7.3.1 BOOTING SINGLE DENSITY DY-BASED DISKETTES IN THE MF-211

To bootstrap the single density system created above without the aid of a BDV-11, two alternatives are available. Use the diskette that CRDS supplies along with the purchase of RT-11 or follow the instructions in Section 7.3.1.1.

##### 7.3.1.1 MANUAL BOOTING OF SINGLE DENSITY DY-BASED SYSTEM DISKETTES

Another method of booting single density DY-based system diskettes is through the use of ODT. A list follows of the series of deposits necessary to accomplish this along with explanations is given below:

<u>Location of deposit</u>	<u>Value of deposit</u>	<u>Explanation</u>
777170	40000	Init and read sector 1, track 1
777170	3	Transfer the sector (1008 words) to memory Starting at loc 0
777172	100	
777172	0	
777170	7	Read Sector 3 track 1
777172	3	
777172	1	
777170	3	Transfer the sector (1008 words) to memory starting at loc 200
777172	100	
777172	200	
777170	7	Read Sector 5 Track 1
777172	5	
777172	1	
777170	3	Transfer the sector (1008 words) to memory starting at loc 400
777172	100	
777172	400	
777170	7	Read Sector 7 Track 1
777172	7	
777172	1	





7.3.1.1 MANUAL BOOTING OF SINGLE DENSITY DY-BASED SYSTEM DISKETTES (continued)

<u>Location of deposit</u>	<u>Value of deposit</u>	<u>Explanation</u>
777170	3	Transfer the sector (100 words) to memory starting at loc 0
777172	100	
777172	600	
R0	0	Zero R0 and R7
R7	0	
RS	200	Disable interrupts
Then with the halt/enable switch enabled, type P, and the system should boot.		

The sequence of key strokes the user must perform to accomplish this follows:

```

777170/40000 <CR>
/3 <LF>
100 <CR>
/0 CR
777170/7 <LF>
3 <CR>
/1 <CR>
777170/3 <LF>
100 <CR>
/200 <CR>
777170/7 <LF>
5 <CR>
/1 <CR>
777170/3 <LF>
100 <CR>
/400 <CR>
777170/7 <LF>
7 <CR>
/1 <CR>
777170/3 <LF>
100 <CR>
/600 <CR>
R0/0 <CR>
R1/177170 <CR>
R7/0 <CR>
RS/340 <CR>
P

```

" <CR> " is a carriage return and not "left angle bracket, C, R, right angle bracket," same for <LF> . " ^ " is "up arrow" and is over the "6" on DEC keyboards. It looks like " ↑ " and is over the "K" or "N" on other keyboards.

Then with the halt/enable switch enabled, type P, and the system should boot.





### 7.3.1.1 MANUAL BOOTING OF SINGLE DENSITY DY-BASED SYSTEM DISKETTES (continued)

Figure 7-1 is a printout of what this, together with the computer's responses, would look like.

```
173000
6777170/004040 40000
0/004040 3
177172/000000 100
0/000000 0
0777170/004040 7
177172/000000 3
0/000000 1
0777170/004040 3
177172/000000 100
0/000000 200
0777170/004040 7
177172/000000 5
0/000000 1
0777170/004040 3
177172/000000 100
0/000000 400
0777170/004040 7
177172/000000 7
0/177170 1
0777170/004040 3
177172/000000 100
0/000000 600
0P0/000000 0
0P1/000000 177170
0P7/173000 0
0P5/000200 340
0P
```

RT-11FB V04.00

FIGURE 7-1

### 7.4 CREATING A DOUBLE DENSITY DY-BASED SYSTEM DISK

Now that you have the system booted, put a blank double density disk in drive 1. (The term double density diskette refers to a diskette that has been formatted with double density data field marks. See Section 4.5 on how to make a double density diskette.) Now execute the following sequence:

```
Initialize the disk in drive 1:
    .INIT/NOQUERY DY1:

Copy the system disk onto it:
    .COPY/SYS DY0:*. * DY:*. *

Load the bootstrap block:
    .COPY/BOOT DY1:DYMNSJ.SYS DY1:
    or
    .COPY/BOOT DY1:DYMNFB.SYS DY1:
```

The disk in drive 1 should now boot if you put it in drive 0 and BOOT the system.

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#### 7.4 CREATING A DOUBLE DENSITY DY-BASED SYSTEM DISK (continued)

You can use any single or double density disks as user disks with this double density disk as the system disk. All system programs should run, and any user programs that don't expect an RX01 on the system should run (i.e., programs that don't reference files with "DX0:" as part of the file name and that don't reference 77717X expecting to find an RX01 there, should run).

#### 7.5 USING THE FORMAT COMMAND UNDER RT-11

In order to format the data fields of a diskette, an RT-11 utility program called FORMAT may be used. In order to use this utility type:

```
.R FORMAT <CR>
```

The program will type an asterisk, after which the user should type the device name, either DY0: or DY1: .

```
*DY0: <CR>
```

After checking to be sure you wish to do this (the format operation, of course, destroys all data), the drive specified will write double density data fields on all sectors of the diskette. If you wish to format the diskette to single density, type DY0:/S instead.

If the operation is interrupted, it should be restarted or an "illegal" diskette of mixed densities will be created. If the operation fails to complete successfully, a problem was encountered in reading the headers of the diskette. The user may attempt to reformat these headers by the procedure given in Section 5.4.5.2. This feature is an additional feature offered by CRDS but not by DEC, therefore it is not contained in RT-11's format utility program.





## Section 8

### PROGRAM-CONTROLLED OPERATION OPTION

The MF-211 is capable of being operated in RX01 emulation mode. In this mode, all data transfers are by program control and only single density storage is available. In this mode the FD-211 will function identically to DEC's RX01 and our older FD-11 product. This is in general of little interest to most users; however, if a user wishes to make absolutely no changes to his operating system, this mode allows that.

For example, because only RT-11-V03-B supports the RX02 instruction set, a user who wishes to use RT-11-V02 could opt for RX01 emulation. He will not be able to make use of double density, however. We suggest that users attempt to keep current with new software releases.

To run in RX01 emulation mode, a new series of microcode ROM's must be purchased if the system was not ordered with this option.

Below are the designations used in ordering:

FC-201	Controller card only with RX01 emulation
MC-201	2-chip PROM set to convert to RX01 emulation mode

#### 8.1 CONFIGURING THE CONTROLLER CARD FOR RX01 EMULATION

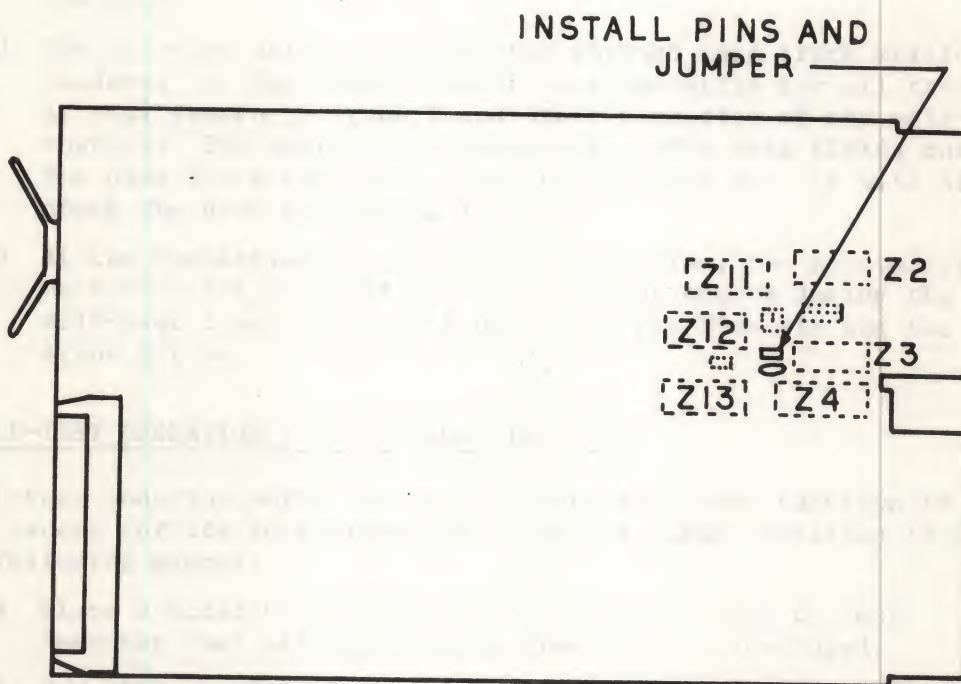
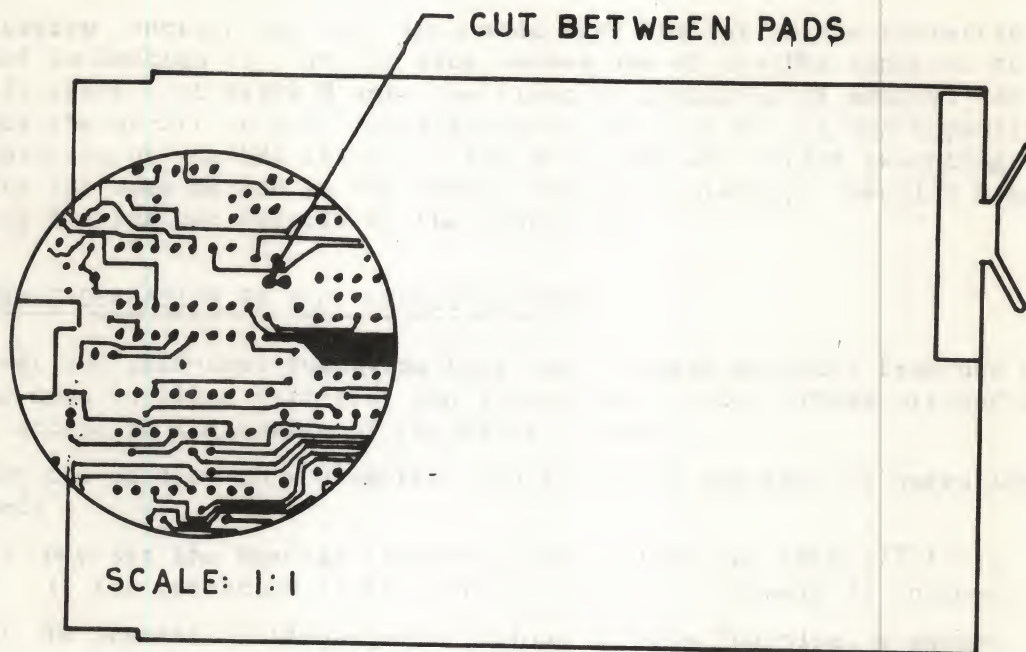
To change the controller card to RX01 emulation mode using the MC-201 PROM kit, perform the following steps:

- (1) Remove the 24-pin PROM's in sockets Z27 and Z28 and save for future use.
- (2) Place the PROM from the MC-201 kit with the lowest program number in socket Z27. The other PROM, whose program number is one greater than Z27, should be placed in Z28. Care should be taken that the integrated circuits are positioned correctly with pin 1 (the notched end of the chip) pointing towards the card's handle. Failure to orient the chips correctly will destroy the PROM's.
- (3) The etch between the two jumper pads shown in Figure 8-1 must be broken. This disables the sending of bit 11 (the RX02 designation bit) to the CPU. (Pins may be installed to allow for changing of this function easily.)

When this procedure is completed, the controller card will emulate the standard RX01 instruction set as described in Section 5 of our MF-11 manual. There have been changes made, however, to the special instruction set, those features supplied by CRDS that are not part of DEC's instruction set. These instructions include bootstrap, format, and self-test and are described in the following paragraphs.







RX01 EMULATION ETCH CUT

FIGURE 8-1





#### 8.4 SELF-TEST OPERATION IN RX01 EMULATION MODE (continued)

- (4) The selected drive will now write each of the 26 sectors on track 0 with a test pattern (consisting of data incremented by 1 each byte). It will then read each of those 26 sectors back again, checking that no CRC error occurred. It will perform this operation on each of 77 tracks.
- (5) The controller will halt on either reaching an error or the completion of track 76. The Done bit will then be set. The self-test here does not repeat itself endlessly as the self-test did in our MF-11 product.





## Section 9

### MAINTENANCE

This section contains the basic maintenance information on the MF-211 needed to service the system by spare parts. It is suggested that only large volume users of the MF-211 attempt to service the system to the component level. It is far better for the majority of users to swap out either a card or a drive in the event of a failure. We have included here the diagnostic and maintenance procedures necessary to do this.

#### 9.1 PREVENTIVE MAINTENANCE

Though the cards and other electronics require no preventive maintenance, all mechanical devices do. Preventive maintenance of the disk drive, however, is minimal due to the efficient design, reliability, and manner in which the unit is operated.

##### 9.1.1 VISUAL INSPECTION

During normal operating conditions, periodically inspect the unit for signs of dirt, wear, or loose latching hardware on the handle. When servicing the unit, check all areas for signs of loose connections, abnormal wear, and dirt accumulation on the flexible disk guide.

##### 9.1.2 CLEANLINESS

A clean disk drive, externally and internally, will extend the operating life of the equipment and enhance the appearance. The importance of periodic visual inspection and normal cleanliness of the unit cannot be over-emphasized. For proper ventilation and heat removal, the fan filters should be cleaned whenever air flow is restricted, or dirt patterns are readily seen on the filter material surfaces.

##### 9.1.3 ROUTINE MAINTENANCE SCHEDULE

A systematic routine operating check is recommended. The checks should be performed in accordance with Figure 9-1.

FIGURE 9-1  
ROUTINE MAINTENANCE SCHEDULE

UNIT	FREQ MONTHS	CLEAN	OBSERVE
Read/Write Head	12	Clean Read/Write Head ONLY IF NECESSARY	Oxide build up
R/W Head Load Button	12	Replace	
Stepper Motor and Lead Screw	12 12	Clean off all oil, dust, and dirt	Inspect for nicks and burrs
Belt	12		Frayed or weakened areas
Base	12	Clean base	Inspect for loose screws, connectors, and switches
Read/Write Head	12		Check for proper alignment

# Inventory

Inventory of the collection of the Department of the Interior, Bureau of Land Management, for the year ending June 30, 1900.

The following is a list of the items in the collection, with their respective values, and the total value of the collection.

The collection consists of the following items:

1. A collection of the following items:

2. A collection of the following items:

3. A collection of the following items:

4. A collection of the following items:

5. A collection of the following items:

Item	Value	Total
1. A collection of the following items:	100.00	100.00
2. A collection of the following items:	200.00	300.00
3. A collection of the following items:	300.00	600.00
4. A collection of the following items:	400.00	1000.00
5. A collection of the following items:	500.00	1500.00
Total		1500.00



## 9.2 DIAGNOSING THE PROBLEM

The MF-211 is composed of three major sections: the computer electronics (all cards on the bus), the drives, and the power supply. Many times a problem will be caused by just one of these subsystems. We often can isolate the problem to the failing subsystem and replace it.

If the computer won't run, try operating it with as few cards as possible, trying to eliminate the bad card or subsystem. The MF-211 can run programs with only the processor, memory and a console interface on the bus.

Also refer to the Section 9.2.1. This section lists some common problems with MF-211 systems. If this does not help, check the power supply (Section 9.2.2) and run the diagnostics (Sections 9.2.3 and 9.2.4).

### 9.2.1 COMMON PROBLEMS

<u>Problem</u>	<u>Possible Cause</u>	<u>Remedy</u>
LED on drive "0" stays on, run LED is off, no terminal response (when booting)	No disk in drive "0" DMA chain broken No double density boot on diskette	Insert Diskette Check card placement  Replace diskette
Processor is in ODT, run LED is off, LED's on drives flash once (when booting)	Interrupt chain broken Halt/Enable switch in halt position Processor is not strapped to come up in mode 2	Check card placement Switch to run  See Section 4.2
Many retries on a write	Diskette is write protected Bad diskette (headers not readable) Head dirty Worn load pad	Write enable the diskette Try a /K in DUP  Check, clean Check, replace
Many retries on a read	Bad Diskette Head dirty Worn load pad	Try a /K in DUP Check, clean Check, replace

1. The first part of the report deals with the general situation of the country and the progress of the work during the year. It is a summary of the work done and the results obtained. It is a general statement of the work done and the results obtained. It is a general statement of the work done and the results obtained.

2. The second part of the report deals with the details of the work done during the year. It is a detailed statement of the work done and the results obtained. It is a detailed statement of the work done and the results obtained. It is a detailed statement of the work done and the results obtained.

3. The third part of the report deals with the financial statement of the work done during the year. It is a financial statement of the work done and the results obtained. It is a financial statement of the work done and the results obtained. It is a financial statement of the work done and the results obtained.

4. The fourth part of the report deals with the conclusions of the work done during the year. It is a statement of the conclusions of the work done and the results obtained. It is a statement of the conclusions of the work done and the results obtained. It is a statement of the conclusions of the work done and the results obtained.



### 9.2.2 POWER SUPPLY

The MF-211 power supply is a multiple voltage source for all elements in the chassis box. DC voltages of -5, +5, +12 and +24 volts are supplied. The adjustments available are: +5 volts, +12 volts and +24 volts.

The power supply also contains circuitry for the generation of the line time clock signal and DC power good signals.

#### 9.2.2.1 SPECIFICATIONS

Input:

120 VAC, 50/60 Hz, at 7.5 amps, circuit breaker protected  
or optionally 220 VAC, 50/60 Hz, at 4 amps.

Outputs: (second pin listed is ground)

+5 VDC at 2 amps	J3, pins 5 and 6
+5 VDC at 2 amps	J4, pins 5 and 6
+5 VDC at 10 amps	J5, pins 1 and 2
+5 VDC at 10 amps	J5, pins 3 and 4

Total +5 volt draw limited at 25 amps.

+12 VDC at 4 amps	J5, pins 6 and 7
+24 VDC at 2 amps	J3, pins 1 and 2
+24 VDC at 2 amps	J4, pins 1 and 2
-5 VDC at 0.5 amp	J3, pins 3 and 4
-5 VDC at 0.5 amp	J4, pins 3 and 4
-5 VDC at 0.5 amp	J5, pins 5 and 8

POK is asserted low when all voltages compare properly with corresponding references.

CLK, line frequency clock signal

#### 9.2.2.2 REMOVAL OF POWER SUPPLY

**WARNING**

ALWAYS REMOVE AC PLUG FROM MF-211 CABINET  
BEFORE REMOVING SUPPLY. POWER SUPPLY  
COMPONENTS MAY BE HOT AFTER OPERATION.

It may be necessary to replace or service the power supply in the field. The power supply is mounted as a single module, and can be easily removed:

Dear Sir,  
I have the honor to acknowledge the receipt of your letter of the 10th inst. in relation to the above matter.

I am sorry to hear that you are not satisfied with the result of the examination.

I have been very anxious to see that the examination was conducted in a fair and equitable manner, and I am confident that the result is correct. I am sorry that you are not satisfied, but I am unable to do anything more at this time.

I am sure that you will understand my position, and I am sure that you will be satisfied with the result of the examination. I am sure that you will be satisfied with the result of the examination.

I am, Sir, very respectfully,  
Your obedient servant,  
J. H. [Name]

Yours truly,

J. H. [Name]

I am, Sir, very respectfully,  
Your obedient servant,  
J. H. [Name]



#### 9.2.2.2 REMOVAL OF POWER SUPPLY (continued)

- (1) Turn power off and disconnect line plug.
- (2) Remove front panel.
- (3) Remove top cover (as per Section 3).
- (4) Remove the 4-pin connector J6 from power supply board. Note that this connector contains a blocking pin in an unused position to provide polarity.
- (5) Remove the keyed mate-and-lock connectors J3, J4, and J5 by pressing in on the handles and gently rocking back and forth while pulling out. Considerable effort may be required.
- (6) Separate the three-wire AC connector by pulling it apart.
- (7) Separate the two additional connectors used for the fans.
- (8) Remove the four power supply mounting screws from the outer surface of the enclosure's rear panel behind the power supply.
- (9) Lift the supply module straight up and out of enclosure.

Simply reverse the operation to re-install power supply. The unit is mounted with the heat sink down and components facing the center of the chassis box.

#### 9.2.3 MF-211 DIAGNOSTIC

Several useful diagnostics are available to the user. The simplest one is built into the microcode of the FC-202 controller. Place a good diskette into drive 0 and init the system with the halt switch in the halt mode. Examine location 177170 using ODT. If the error bit (bit 15) is set, the nature of the error can be determined by looking at location 777172 for simple errors, and performing the read error code function for other errors as described in Section 5.4.8.

For problems that are not solid, the self-test function as described in Section 6.4 should be performed. Try to isolate the problem to a single drive or the media.

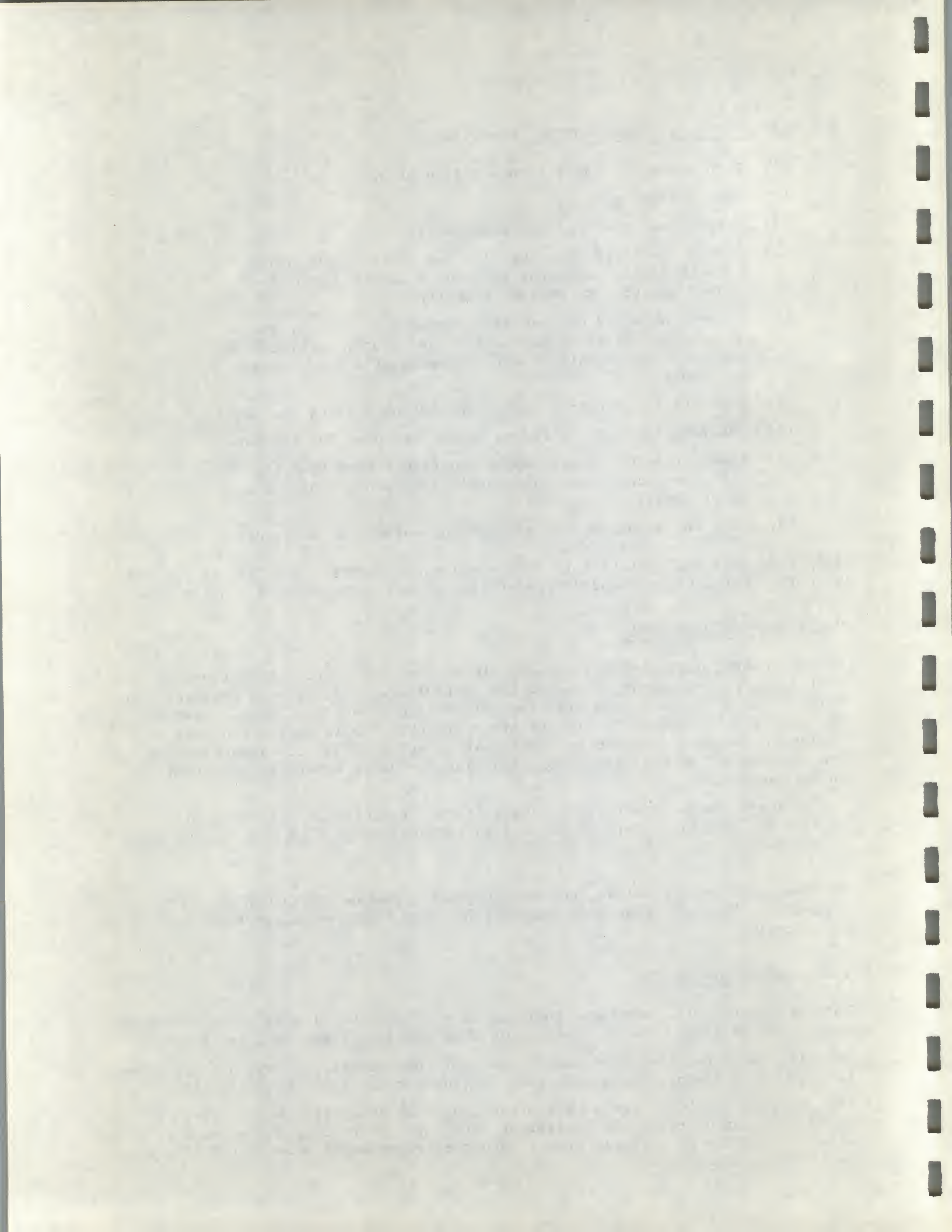
For more difficult problems, the DEC diagnostic package CZQXAKO XXDP is suggested. This contains test programs for many cards and subsystems of the LSI-11.

#### 9.2.4 ZRXDA DIAGNOSTIC

This diagnostic will provide a thorough test of the FD-211 subsystem. The diagnostic may be loaded from diskette only when the line time clock is disabled.

The diagnostic provides many modes selectable by the user, in which to test the FD-211. This diagnostic is especially useful for testing data reliability.

120, 160, or 200 (CRC) errors are often caused by defective media, drive or read/write circuitry on the controller card. Try to isolate the problem to either the media or a single drive. Other error messages usually indicate a faulty controller card.





### 9.2.5 DRIVE REPLACEMENT

Problems with a single drive in a dual drive system usually indicate a problem in the failing drive, rather than the controller. If the problem can be isolated to one drive, the drive should be removed for repair or replacement. The remaining drive can be configured to respond as drive 0 or drive 1 (see Section 9.2.5.1). Follow the procedure outlined below to remove drives:

- (1) Remove the 50-pin ribbon cable edge connector from the drive.
- (2) Unplug the 3-terminal AC power connector from the drive.
- (3) Unplug the 6-terminal DC power connector from the drive.
- (4) Remove the four screws that hold the drive in place from the bottom of the unit.
- (5) Remove the two screws that hold the drive in place from the side of the unit.
- (6) Slide the unit forward and out.
- (7) A replacement drive may be installed by reversing the above procedures. The proper jumper configuration of such a drive is given below.

#### 9.2.5.1 DRIVE CONFIGURATION

The Shugart SA-800R drive contains a PC card with silk screen designations for various jumpers. There are two differences between the jumper configuration in the FD-211 and the standard configurations used by Shugart.

- (1) The jumper marked HL is moved to DS.
- (2) The jumper marked DS1 is removed. If one wishes the drive to respond as unit 0, place this jumper at DS3. For response as unit 1, the jumper should be placed at DS4.

### 9.2.6 FC-202 CONTROLLER CARD REPLACEMENT

The controller card consists of a 6 MHz bipolar bit slice microprocessor that controls almost all functions performed by the controller. DMA bus cycles, reading and writing of the disk, and RX02 instruction set emulations are handled by this processor. The few functions in hard logic include DMA grant arbitration, interrupt acknowledge arbitration, and the phase-locked loop, used to track data from the disk on read operations.

The phase-locked loop is the only analog circuitry on the board and contains an inductor and capacitor to isolate the VCO chip from the digital logic. The effective isolation may be checked by placing a scope on Z45 pin 16, AC coupled. There should be less than 30 millivolts of noise. Other checks that may be made on this circuitry are listed below. These checks should be performed when the reliability of reading data is in question.





#### 9.2.6 FC-202 CONTROLLER CARD REPLACEMENT (continued)

- (1) Check the single density bit cell divider one-shot at Test Point 5 (Z44 pin 12). During read operations, this one-shot will be triggered and using a scope set on negative-edge triggering, the one-shot should stay low for  $1000 \pm 70$  nanoseconds.
- (2) Check the double density bit cell divider one-shot at Test Point 6 (Z44 pin 4). During read operations, this one-shot will be triggered and using a scope set on negative-edge triggering, the one-shot should stay low for  $500 \pm 20$  nanoseconds.
- (3) Check the voltage level of Test Point 2 with a digital voltmeter while the FD-211 is idle. It should read  $3.0 \pm 0.3$  volts DC.

The FC-202 controller card should be swapped first when trying to isolate any problem that does not appear to be drive-dependent or media-dependent, or if it fails any of the above tests. Turn off the power, remove the card, and inspect it for contaminated gold fingers or any contaminants that might have caused a short. If the card is still not working, it should be returned to CRDS.





## RETURNING MATERIAL

IN THE EVENT THAT IT BECOMES NECESSARY FOR YOU TO RETURN MATERIAL TO CHARLES RIVER DATA SYSTEMS, PLEASE:

1. Phone the factory in advance of your return.

When you call, please have available:

- a. A description of the problem or reason for the return.
- b. The serial number of the unit.
- c. Your original purchase order number, CRDS invoice number, or shipping memo number.

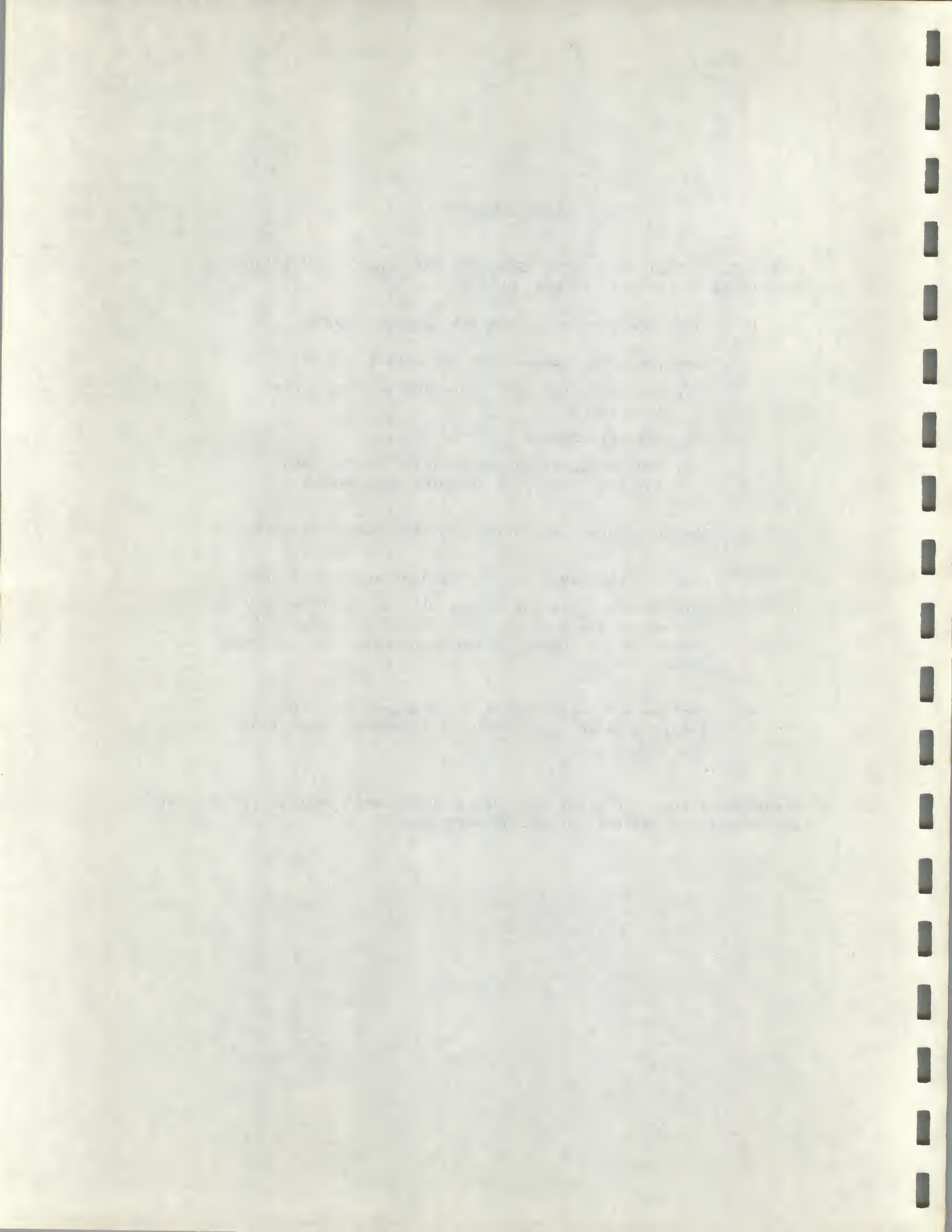
2. Obtain a Return Authorization (RA) Number from CRDS.

3. Show the RA Number on all packages shipped to CRDS.

Parcels which are not marked with an RA Number may be refused at the factory. You should reference this number in all communications concerning the returned goods.

4. Enclose a description of the problem or any other information which may help in expediting repair of the unit.

Please note that a new purchase order number will be required whether the unit is in warranty or out of warranty.





## WARRANTY

### CHARLES RIVER DATA SYSTEMS, INC.

All equipment purchased directly from CRDS, its authorized representatives and/or franchised distributors is warranted on "return-to-factory" basis against defects in workmanship and materials under normal and proper use in its unmodified condition for a period of ninety (90) days from date of initial shipment. As a condition of this warranty, Customer must (a) obtain a CRDS Return Authorization (RA) Number, (b) ship the equipment (or sub-assembly) to the designated CRDS repair point, transportation prepaid, and (c) include with the returned equipment (or sub-assembly) a WRITTEN description of the claimed defect. Transportation charges for the return to Customer of in-warranty repaired equipment (or sub-assembly) shall be paid by CRDS within the fifty (50) United States, District of Columbia, and Canada. Returns to customer of out-of-warranty repaired equipment (or sub-assembly) shall be "Transportation Collect". If CRDS determines that the equipment (or sub-assembly) returned to it for warranty correction is not defective as herein defined, Customer shall pay CRDS all costs of handling and transportation. All repaired or replaced equipment shall be returned only to Customer and not to third parties to whom Customer may have sold, leased or otherwise transferred the equipment. The warranties provided herein are exclusive to the Customer only.

Charles River Data Systems, Inc., hereby warrants all equipments (or sub-assemblies) of first party manufacturers and/or their authorized, franchised representatives and distributors against defects in workmanship and materials, only to the full limits and extent that such items are warranted to CRDS.

This warranty is expressed in lieu of all other merchantability warranties expressed or implied (including the implied warranty of fitness for a particular purpose) and of all other obligations or liabilities on CRDS's part, and CRDS neither assumes nor authorizes any other person to assume any other liabilities in connection with the sale of the said article.







